Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Prepared for
Todd Pacific Shipyards Corporation

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FINAL

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1.0 Introduction

This document presents the Final Operation, Maintenance, and Monitoring Plan (OMMP) for remedial actions performed at the Todd Shipyards Sediment Operable Unit (TSSOU or Site) of the Harbor Island Superfund Site in Seattle, Washington. This report describes the long-term maintenance and monitoring activities that will be conducted within the TSSOU to assure long-term effectiveness of the constructed remedy as documented in the Final Remedial Action Completion Report (RACR; Floyd|Snider 2007). This Final OMMP represents advancement from the Draft Final OMMP submitted to the U.S. Environmental Protection Agency (USEPA) in August 2004 (FSM Team 2004c) and the USEPA Review Draft OMMP submitted to USEPA in April 2006 (Floyd|Snider 2006). This document includes changes to the previous versions of the OMMP based on USEPA comments, changes to the design that were implemented during remedial action construction, and experience with implementation of monitoring methods during construction.

The OMMP is a formal USEPA deliverable that meets the requirements of the Remedial Action and Long-term Monitoring Statement of Work (SOW) for the TSSOU (USEPA 2003c). This OMMP is consistent with project requirements addressed in the site Record of Decision (ROD; USEPA 1996), two Explanations of Significant Differences (ESDs) written by USEPA to augment the ROD (USEPA 1999, 2003a), the Administrative Order on Consent for Remedial Design (AOC; USEPA 2000), and the Consent Decree (CD; USEPA 2003b). Additional supporting documents referenced by the OMMP include the following:

- Final RACR (Floyd|Snider 2007)
- Construction Quality Assurance Plan (CQAP), Appendix A of the Remedial Action Work Plan (RAWP; FSM 2004a)
- Remedial Action Sampling and Analysis Plan and Quality Assurance Project Plan (RASAP and QAPP), Appendix B of the RAWP (FSM 2004a)
- Source Control Report, TSSOU (FSM 2003b)
- Source Control Report Addendum (Floyd|Snider 2004)
- National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-000261-5. Todd Pacific Shipyards Corporation (Ecology 2004)

In addition to the above-referenced documents, all work performed on-site will be performed in accordance with a Health and Safety Plan (HSP) and Appendix C of the RAWP (FSM 2004a), which meets the Remedial Action SOW requirements for an HSP. Contractors and consultants performing site work under the OMMP will be required to prepare project-specific HSPs specific to the scopes of work being performed. HSPs will meet Remedial Action SOW requirements.

A summary of the regulatory requirements, remedial design, and construction of the remedial action is presented in Appendix A.

1.1 PURPOSE AND SCOPE

The purpose of the post-remedial OMMP is to ensure the TSSOU remedial action has achieved its performance objectives as specified in the ROD and subsequent ESDs. The remedial action cleanup objective for the TSSOU, as stated in the ROD, is to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms (USEPA 1996). Post-remedial action maintenance and monitoring activities will also be performed at the TSSOU to verify the continued long-term effectiveness of the remedy in protecting human health and the environment, as required by the Remedial Action and Long-term Monitoring SOW.

In order to meet the remedial action objective, contaminated sediments and shipyard waste have been removed from the open-water areas by dredging to depths where contaminant concentrations are less than chemical and/or biological sediment quality standards (SQS) as defined by the Washington State Sediment Management Standards (SMS; Chapter 173-204 WAC; Ecology 1995). Sediment samples were collected from the post-dredge surface and compared to SQS to verify that performance standards were achieved. Along a portion of the northeast shoreline a permanent sediment cap was placed to isolate contaminants that could not be removed through dredging to meet the RAO.

Two pier structures that had reached the end of their serviceable life were demolished to allow dredging of underlying sediments. The remaining serviceable piers still in use at Todd consist of piers supported by wooden piles and piers supported by steel piles. Under these piers temporary sand caps were placed to meet the RAO in these areas where no dredging occurred. Due to concern for structural stability (due to lateral loading pressures) and technical feasibility, the wooden pile piers received 1 foot of a sand cap and the steel pile piers received 3 feet of a sand cap. The under-pier sand caps are not expected to provide chemical containment of underlying sediments, and the under-pier sand is expected to be subject to movement. Until the time that the piers are removed and these areas are permanently remediated, these capped areas are subject to long-term monitoring to confirm that some amount of sand cap material remains in place to meet the RAO. Along the western shoreline, significant habitat improvements were made by constructing an intertidal habitat bench beneficial to juvenile salmon. Todd has committed to maintaining this habitat bench surface over the long-term as well.

This OMMP describes long-term monitoring and maintenance to be completed after the completion of the TSSOU remedial action. The OMMP sets forth specific performance standards for planned monitoring activities to demonstrate that the long-term objectives for the project are met. The OMMP also describes potential response actions that may be implemented if monitoring results indicate that the remedy is not meeting the long-term performance standards.

Revisions will be made to the OMMP, if they are determined to be necessary to improve or better describe the operations, maintenance, or monitoring process. Procedures for amending or revising the OMMP are included in Sections 9.0 and 10.0.

1.2 OMMP ORGANIZATION

This OMMP for the implemented TSSOU remedy addresses the following elements:

- **Section 2.0 Project Organization and Responsibilities:** Presents the project organization for the operation, maintenance, and monitoring activities at the Site.
- **Section 3.0 Project Objectives and Monitoring Strategy:** Identifies the remedial action objective for the Site and provides an overview of the remedial activities that are subject to this OMMP.
- **Section 4.0 Performance Standards and Early Action Warning Levels:** Provides the performance standards that will be used to assess whether the remedial objective continues to be met at the TSSOU.
- **Section 5.0 Physical Integrity Monitoring:** Provides details on the physical integrity monitoring program to determine cap integrity over time.
- **Section 6.0 Institutional Control and Best Management Practices (BMPs):** Provides a summary of TSSOU institutional controls and BMPs to be implemented.
- **Section 7.0 Long-term Effectiveness of Source Control Actions:** Provides a summary of the long-term effectiveness of stormwater and dry dock grit management source control.
- **Section 8.0 Documentation and Reporting Schedule:** Provides a summary of the required reports and reporting requirements.
- **Section 9.0 Contingency Planning and Response:** Provides details on the response actions to be taken in the event that monitoring results indicate that performance standards are not being met.
- **Section 10.0 Monitoring Frequency Reduction Request Procedures:** Provides a summary of procedures for revising the OMMP to reduce monitoring if results show over time that stable conditions are met.
- **Section 11.0 Amendments to the OMMP:** Provides a summary of procedures for amending the OMMP if deemed necessary.
- **Section 12.0 Standard Operating Procedures:** Provides a list of standard operating procedures that are anticipated to be used during monitoring.

1.3 CHEMICALS OF CONCERN AND CLEANUP LEVELS

The chemicals of concern (COCs) in the TSSOU sediments include arsenic, copper, lead, mercury, zinc, tributyltin (TBT), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs).

The cleanup standards identified in the ROD and subsequent ESDs for the TSSOU are chemical and/or biological SQS as defined by the Washington State SMS (Chapter 173-204 WAC). The one exception is for TBT, where no SQS criterion exists and the compliance criterion is based on the West Waterway confirmational number stated in the 2003 ESD and discussed below. COCs for the TSSOU and their corresponding compliance criteria are included in Table 1.1. If both chemical and biological data are collected, the biological data determine compliance with the SMS.

Concentrations of COCs that are characteristic of the West Waterway, located adjacent to the TSSOU, were defined in the 2003 ESD and referred to as West Waterway confirmational numbers. These confirmational numbers were used by USEPA to adjust the TSSOU boundary for the remedial action and the ESD stated these numbers could also be used to determine potential future recontamination at the Site once the remedial action was constructed. The West Waterway confirmational numbers are also included in Table 1.1.

1.4 DEMONSTRATION OF MEETING REMEDIAL ACTION OBJECTIVES

This section summarizes how the completed remedial action meets the TSSOU RAO and satisfies the remedial action requirements (as further described in Appendix A).

1.4.1 TSSOU Dredging

In order to meet the RAO, contaminated sediments and shipyard waste were removed from the open-water areas of SMAs 1–9 by dredging to depths where contaminant concentrations were less than chemical and/or biological SQS. Dredging was performed following the construction quality assurance procedures stated in the RAWP (FSM 2004). Sediment samples were collected from the post-dredge surface and compared to SQS to verify that performance standards were achieved. Sediment sampling and analysis was performed in accordance with the RASAP and QAPP (Appendix B of the RAWP; FSM 2004).

A total of 67 sediment samples were collected from the post-dredge surface in SMAs 1–9 to evaluate compliance with SMS criteria. Two of these samples from the Northeast Shoreline were also submitted for bioassay testing and evaluated for compliance using SMS biological criteria. One of the bioassay locations did not pass the SMS biological criteria; this area has been addressed by placement of a permanent sediment cap, discussed below in Section 1.4.3. The remaining 65 samples were compared to SQS chemical criteria to evaluate compliance. Analytical results for these samples are presented in Appendix B, along with Figure B.1 showing the sampling locations.

Out of 569 chemical analytical results (from 64 samples collected from SMAs 1–9, excluding sample TSP-06-08 which is discussed below in Section 1.4.2), 12 samples exceeded the SQS for mercury alone, one sample exceeded the SQS for LPAHs alone, and one sample exceeded the SQS for mercury and LPAHs (refer to Appendix B). In summary, 97.4 percent of the sample analytical results are less than the SQS chemical criteria.

The combined database of TSSOU chemical compliance results, excluding those from TSP-06-08, was evaluated statistically to assess compliance with cleanup criteria using USEPA guidance for statistical evaluation of confirmational sample results (USEPA 1989). The results of this statistical evaluation, presented in the RACR, indicate that the average (mean) concentration and the upper 95 percent confidence level on the mean concentration for all COCs are less than SQS chemical criteria for all analytes. Based on this statistical evaluation, Todd and USEPA have concluded that the post-dredge surface in all these areas of the Site meets cleanup criteria and no further work is required in these areas.

Post-remediation bathymetry for the TSSOU is provided in Figures 1.1a through 1.1e.

1.4.2 Habitat Bench Construction in Sediment Management Area 6

Despite significant re-dredging of the bench area, sample TSP-06-08 collected from the northern end of the SMA 6 habitat bench, had SQS exceedances for several constituents, including copper, lead, mercury, zinc, LPAHs, and HPAHs.

In consultation with USEPA it was determined that in lieu of conducting additional dredging a minimum 2-foot-thick sand cover would be placed over the entire bench area prior to placing a 3-foot-deep layer of Habitat Mix. The logic and rationale supporting this decision are summarized as follows:

- Initial dredging and follow-on re-dredging of the bench was accomplished using an environmental dredge bucket with dredging extending into native sediments.
- Core-logs indicated that sediment materials exceeding cleanup criteria consisted of a thin veneer (less than 4 inches thick) of re-distributed sediments.
- The area of the zone represented by sample TSP-06-08 is very small (7,500 square feet). This area represents only 0.6 percent of the total open-water area (26.9 acres) dredged within the TSSOU. This area represents a very small percentage (0.5 percent) of the total remediation area (approximately 32 acres) at the TSSOU, and therefore poses little risk to the environment.
- Chemical exceedances in sample TSP-06-08 were generally less than the cleanup screening level (CSL), expect for a minor exceedance of the CSL for copper (SQS and CSL are the same for copper) and a significant exceedance for lead.

Coast & Harbor Engineering performed a design evaluation study for the Todd project to confirm the grain-size distribution of the material to be placed on the SMA 6 habitat bench. The study evaluated wave action and erosive forces that would be acting on the habitat bench in SMA 6. This study is included as Appendix C. It was concluded that a material mix with a much larger grain-size component (coarser and more stable material including cobble sized rock) was the preferred material for the habitat bench compared to the habitat mix used on the other riprap slopes at the Site. The grain-size distribution of this material, termed Type 2 Habitat Mix, is included in Figure 1.2.

The habitat bench was constructed in accordance to the revised design. The habitat bench consists of a minimum 2-foot thickness of sand and a post sand-placement bathymetric survey of the habitat bench verified that appropriate sand thicknesses had been achieved. A minimum 3-foot-thick layer of Type 2 Habitat Mix was then placed on top of the sand. A post placement bathymetric survey was used to verify that the surface of the habitat bench met design grades. Cross sections of the habitat bench are shown in RACR Figure 4.3. A plan view of the post-fill conditions for the habitat bench is provided on Figure 1.1e.

Todd has committed to long-term physical integrity monitoring of this habitat bench in SMA 6 to ensure the stability of the habitat mix substrate.

1.4.3 SMA 2 Northeast Shoreline East Area Sediment Cap

Following the maximum extent of shoreline dredging in SMA 2, progress samples of the post-dredge sediment surface indicated that contamination greater than cleanup criteria

remained. Additional characterization was conducted on the post-dredge surface, including bioassay analysis, to delineate the area that would require permanent capping. That supplemental characterization of the post-dredge surface in SMA 2 indicated that the 0.34-acre East Area required permanent capping to isolate contaminants that could not be removed through dredging.

The shoreline fill section was designed to isolate underlying sediments in perpetuity, and attenuate dissolved contamination such that cleanup criteria is met at the cap surface. Geotechnical design of the shoreline fill at the TSSOU confirms that the fill has been constructed in a manner that will maintain permanent physical stability and isolation given the hydrodynamic forces at the Site. Comparison of the supplemental shoreline characterization data to the data used in the adjacent Lockheed Shipyard Sediment Operable Unit (LSSOU) sediment cap design contaminant transport modeling confirms that the sediment cap has been constructed to adequately provide chemical containment of contaminants exceeding the TSSOU cleanup criteria. For additional information refer to Appendix C of the RACR, which describes how the shoreline fill section placed in SMA 2 was implemented to meet the requirements for a permanent cap.

The Northeast Shoreline slope required placement of two types of materials: (1) a gravelly sand, placed immediately above the post dredge surface, and (2) riprap, placed above the gravelly sand. It was determined that all other areas of the shoreline fill would be constructed such that a minimum 2–foot-thick isolation layer of gravelly sand material would be placed below the planned 3-foot riprap layer. The 2-foot gravelly sand layer was specified to match the requirements of the isolation layer designed for the LSSOU, as the LSSOU cap design was approved for containment of similar COCs. One of the original goals of the Northeast Shoreline fill was to create preferential elevations for aquatic habitat. To meet this goal, most areas of the fill cross section have well in excess of the minimum 2 feet of gravelly sand fill below the riprap armor layer. In some places, this material is greater than 20 feet thick.

The construction process typically involved placing material from the bottom of the slope and progressively working upslope. Placement iteratively involved building a riprap berm at the toe of the slope and then filling the zone between the riprap berm and the adjacent face of the slope with gravelly sand. Post fill bathymetric surveys of the Northeast Shoreline slope were conducted as slope construction progressed to confirm that fill was being placed to proper grades. A plan view of the post-fill bathymetry of the shoreline slope is provided on Figure 1.1b and cross-sections of the final post-fill grades are provided on RACR Figures 4.1a through 4.1c.

Habitat mix was placed over the riprap surface above elevation –10 feet mean lower low water (MLLW) following completion of reconstruction of the Northeast Shoreline slope.

This OMMP covers the implementation of the monitoring and maintenance of the riprap surface to ensure that the fill area remains in place and is not eroded or otherwise disturbed.

1.4.4 Under-pier Capping

Remedial action objectives were met in under-pier areas by placing sand cap material in accordance with the construction quality assurance procedures presented in the RAWP (FSM 2004). Sand caps were placed under Piers 1A, 1, 2P, 3, 6, and 6P and within the over-water areas of the building berth to an average thickness of 1 foot and under Piers 4N and 5 to an

average thickness of 3 feet. These were the maximum thicknesses of sand that were determined to be structurally allowable in the final design process. Sand thicknesses are constrained by the allowable forces placed on the pier structures. The volumes of sand placed, along with average thicknesses placed beneath the piers are included in RACR tables. In all cases the caps extend beyond the pier footprints to include the “no dredge zone” areas immediately adjacent to the piers. Additionally, a 4-inch thick shotcrete cap was applied to the large consolidated debris mound under Pier 6P in order to contain and limit exposure and access to the materials.

The under-pier sand cap material was intended to provide environmental benefits by reducing exposure to contaminated sediment and source control by reducing the movement of underlying sediments. In addition, the cap material was intended to provide improved substrate conditions for fish and other habitat enhancement benefits. A best-effort requirement for placement of the under-pier sand cap material was defined. The performance objectives for the sand caps were limited by placement constraints. The sand cap material was not expected to provide chemical isolation of underlying sediments, and it was expected to be subject to movement.

Maintaining some thickness of sand cap material in the under-pier areas over the long-term is included in this OMMP. Contaminated sediments under the piers and within the over-water areas of the building berth will be fully remediated, after demolition, when the existing structures reach the end of their serviceable life.

1.5 ESTABLISHMENT OF BASELINE DATA FOR OMMP

The baseline data described above in Section 1.4 documents initial conditions of the remediated TSSOU for the purpose of comparing data obtained during the course of the long-term maintenance and monitoring period. Additionally, baseline surveys of the under-pier sand cap areas, the Northeast Shoreline Sediment Cap, and the Western Shoreline Habitat Bench are planned as part of this OMMP to visually document the initial coverage of these areas for comparison in future monitoring events. These OMMP baseline surveys are discussed in Section 5.0.

1.6 ADJACENT SHIPYARD SOURCE CONTROL

Prior to remedial action construction, Todd implemented two primary source control projects to eliminate shipyard sources of sediment contamination. Stormwater management infrastructure was reconstructed throughout the primary industrial areas of the yard and operational changes were made regarding the handling of sandblast grit.

1.6.1 Shipyard Stormwater Discharges

Six stormwater drainage basins and associated outfalls at Todd were identified by the Washington State Department of Ecology (Ecology; via the National Pollutant Discharge Elimination System [NPDES]/analysis of all known, available, and reasonable methods of prevention, control and treatment [AKART] analyses process) to be of concern as a source of contaminants to water and sediment quality. Significant stormwater system modifications; involving collection, pre-treatment, and discharge to an off-site Publicly Owned Treatment Works (POTW), were implemented in 2003. This project successfully eliminated stormwater

discharges as a source of sediment recontamination within the TSSOU. For this work, Todd received the Mayor's "BEST Award" and the U.S. Coast Guard's prestigious "Admiral William H. Benkert Award" acknowledging excellence in stormwater pollution prevention.

Further discussion of long-term stormwater source control at the Site is included in Section 7.1.

1.6.2 Shipyard Operations

Based on in-place controls via Best Management Practices (BMPs) and other related shipyard practices, the risk of sediment recontamination from shipyard operations is low. In-place protocols specify safe hazardous substances work, and minimize the risk of environmental spills during operations such as oily sludge removal and refueling. Painting is performed in well-controlled environments, and the leaching of TBT from paints as an on-going TBT source is minimized due to a phase-out of TBT-containing paint usage.

To address the risk of spent sandblast grit releases to sediments via dry dock operations, Todd implemented new dry dock spent grit management protocols in 2003 prior to the initiation of remedial actions in the TSSOU. These included eliminating use of Dry Dock 2 (this dry dock has since been demolished and disposed of), improving the dry dock wash water collection and treatment system, and using spent grit containerization on the dry docks to eliminate transport, stockpiling, and double handling of loose grit within the shipyard.

A discussion of the long-term dry dock grit management source control is included in Section 7.2.

1.7 POSSIBLE SOURCES OF RECONTAMINATION

There are several potential mechanisms that could give rise to elevated chemical concentrations in the TSSOU sediments in the future. These mechanisms include:

- Dry dock discharges (managed under NPDES)
- Stormwater collection system overflow discharges (anticipated to occur less than once every 10 years)
- Full erosion of under-pier sand caps
- Direct discharge from spills
- Transport, resuspension, and redeposition of contaminated Duwamish River and West Waterway Sediment

2.0 Project Organization and Responsibilities

This section presents the project organization for the operations, maintenance, and monitoring activities at the TSSOU. The USEPA and Todd Shipyards are the two main parties involved in this work.

2.1 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

The USEPA is the regulatory authority and responsible agency for overseeing and authorizing sediment remediation activities. In this capacity, USEPA will review the OMMP and associated documentation developed in accordance with the requirements of the CD. The USEPA's review process will ensure that sediment remediation activities are consistent with the technical and administrative objectives of the project. USEPA will also review data collected and corrective action plans relative to needed repairs during the operations, maintenance, and monitoring period. USEPA representatives will also participate in project meetings, perform site inspections, and review project progress and documentation. The USEPA will also approve any modifications to the OMMP in terms of frequency of monitoring or repair. USEPA approval is required for any changes to the OMMP that may affect public health or the environment.

2.2 TODD PACIFIC SHIPYARDS

Todd is the owner of the uplands adjacent to the TSSOU and lessee of portions of the tidelands area, which are owned by the Department of Natural Resources (DNR). Todd is responsible for performing the TSSOU operations, maintenance, and monitoring activities included in this document. Todd personnel will provide overall management and oversight of these activities, along with space allocation, site access, and other miscellaneous support items associated with planning and performance of the work.

The OMMP work will be performed by qualified personnel (both Site personnel and various subcontractors) under the direction of Todd. These activities will include sampling, field testing, data analysis, interpretations, and reporting. Technical consulting and site personnel assigned to the project will have the experience and or training required to complete their project assignment.

2.3 OPERATION, MAINTENANCE, AND MONITORING CONTRACTORS

Operation, maintenance, and monitoring contractors may include bathymetric surveyors, divers, and construction companies. These contractors would be tasked to perform monitoring, maintenance, and repair activities and will be selected by Todd. These contractors will be required to provide a site-specific Health and Safety Plan. With regard to this OMMP, the contractors will comply with quality assurance and documentation requirements as described in the RAWP (Appendix A of the CQAP).

2.4 ANALYTICAL LABORATORIES AND MATERIAL TESTING LABORATORIES

Chemical laboratories will be used to perform laboratory test to support any water quality and sediment quality monitoring required. These laboratories will be responsible for conducting chemical testing following USEPA-approved methods, as described in the project Remedial Action Work Plan RASAP and QAPP.

Specialty material testing laboratories will be used to perform field and laboratory tests to support various components of the OMMP. Material testing will include physical samples collected during diver visual surveys to determine the grain-size distribution of the material in place. Grain size and other physical parameter testing of imported cap materials will also be conducted to confirm specification compliance if cap or habitat mix replacement if necessary.

3.0 Project Objectives and Monitoring Strategy

As stated in the ROD, the remedial action cleanup objective for the TSSOU is to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms. As required by the Remedial Action and Long-term Monitoring SOW, the objective of the OMMP is to verify the continued long-term effectiveness of the remedy in protecting human health and the environment.

The constructed elements of the remedial action that are subject to this OMMP include:

- The under-pier capped areas
- The permanent Northeast Shoreline Sediment Cap
- The habitat bench

These areas are shown on Figure 3.1.

In under-pier capped areas, the cap assists in achieving remedial action objectives by providing new substrate for biological re-colonization and by reducing overall toxicological exposure by reducing physical contact with contaminants by biota. However, the under-pier cap layer is not expected to provide chemical containment, nor is it expected to maintain a static physical distribution. The presence of under-pier pilings affected initial placement of the cap and the continuity of the cap material and thickness. Over time hydrodynamic forces may redistribute or erode the cap material. Under-pier capping is a best-effort, long-term temporary solution. Full cleanup will be performed when piers are demolished at the end of their service life.

The Northeast Shoreline Sediment Cap was designed as a permanent containment cap and the objective for monitoring this cap is to insure that it continues to isolate elevated concentrations of COCs in the underlying sediments from biological receptors. Todd will maintain the riprap surface that armors and protects the sediment cap from erosion, as agreed to by USEPA and Todd during the 2004-2005 construction season. Because this is a heavily riprapped slope, it is unlikely that there would be any movement of materials in the area. However, if cap materials are removed by wave action, erosion or other causes, Todd will replace the materials as appropriate, and implement contingency actions to minimize future erosion events.

The remedial action at the TSSOU provided significant benefits to aquatic habitat by remediating contaminated sediments through dredging and placement of cap and fill materials, thereby providing clean substrates throughout the TSSOU. The remedial action also included several habitat improvements, which provide additional natural resource restoration beyond that achieved by sediment cleanup alone. One of the most significant habitat improvements is the Western Shoreline Habitat Bench, where juvenile salmon habitat was constructed at the base of the bulkhead buttress fill slope. The habitat bench is designed to maximize the area of gently sloping intertidal beach with elevations between +2 and –2 feet MLLW. Surface substrate consists of Type 2 Habitat Mix materials having an approximate grain-size distribution as shown in Figure 1.2. The objective of these materials is to provide a juvenile salmon friendly substrate capable of supporting invertebrate prey and macroalgae productivity while at the same time providing optimal stability relative to wave action.

Although the habitat bench was not constructed as mitigation for construction of the Superfund remedial action Todd is committed to implementing institutional controls and maintenance of the habitat bench surface to ensure that the habitat mix materials remain in place and are not eroded or otherwise disturbed. If the habitat mix materials are removed by erosion to the point where the underlying sand cover materials become exposed, Todd will replace the materials as appropriate, and implement contingency actions to allow the habitat bench to better withstand future erosion events.

Additionally, upland source control monitoring and maintenance activities for Todd's stormwater system and dry dock grit management will be implemented to insure source control requirements are met and that recontamination of the sediments does not occur.

The requirements and specifications for long-term, post-construction maintenance and monitoring activities are presented in this document. In summary, these long-term maintenance and monitoring activities include the following:

- Physical integrity monitoring of under-pier cap areas, with contingencies for maintenance of the caps and potential sampling for COCs in areas adjacent to the piers if erosion of cap material has occurred.
- Physical integrity monitoring of the riprap along the Northeast Shoreline in SMA 2 to ensure stability of the sediment cap, with contingencies for maintenance of the cap if erosion of cap material has occurred.
- Physical integrity monitoring of the habitat bench along the Western Shoreline in SMA 6 to ensure the stability of the habitat mix substrate, with contingencies for maintenance of the habitat mix substrate if erosion of this material has occurred.
- Stormwater source control monitoring through documentation of NPDES permit compliance and monitoring of potential stormwater conveyance system overflows for both NPDES and sediment COCs.
- Monitoring of dry dock abrasive grit blast (AGB) management source control actions through documentation of NPDES permit compliance.

Long-term physical integrity monitoring is discussed in Section 5.0 and the long-term effectiveness of source control actions are discussed in Section 6.0.

4.0 Performance Standards and Early Action Warning Levels

The OMMP establishes the performance standards that will be used to assess whether the remedial objectives continue to be met at the TSSOU. The objectives are described in Section 3.0. Performance standards for the physical integrity monitoring of the under-pier capped areas, the Northeast Shoreline Sediment Cap, and the Western Shoreline Habitat Bench are discussed below. If the performance standards for these three areas are not met, this will indicate significant erosion of material (i.e., sand, riprap, or habitat mix) is occurring and the Contingency Planning and Response process described in Section 9.0 to replace the eroded material will be triggered. Also, discussed below are early warning levels that provide notice of potential problems. Early warning levels are not performance standards, but are set at more stringent levels to assess whether performance standards could be exceeded in the future.

4.1 PHYSICAL INTEGRITY PERFORMANCE STANDARDS

An average 1-foot thick sand cap was placed under Piers 1A, 1, 2P, 3, 6, and 6P and within the over-water areas of the building berth. An average 3-feet thick sand cap was placed under Piers 4N and 5 to reduce physical exposure of biological receptors to underlying contaminants. The performance standard for the under-pier capped areas is to maintain the sand cap to ensure that complete erosion of sand cap material does not exceed a contiguous area of 5,000 square feet. If complete erosion of the sand cap material were to be observed in a contiguous area of 5,000 feet or greater, contingency actions would be triggered.

For the Northeast Shoreline Sediment Cap, a 3-foot riprap layer was placed over a minimum 2-foot-thick isolation layer of gravelly sand material as required for isolation of contaminants in the underlying sediments from biological receptors. The performance standard for this capped area is to maintain the riprap layer to ensure that complete erosion of this riprap does not occur on any area of the cap. Complete erosion of the riprap layer over any area on the cap would trigger contingency actions to replace this riprap.

The performance standard for the Western Shoreline Habitat Bench is maintenance of the Type 2 Habitat Mix to ensure that complete erosion of this material does not exceed a contiguous area of 5,000 square feet. In the habitat bench area, a 3-foot-deep layer of Type 2 Habitat Mix was placed over a minimum 2-foot-thick sand cover. In general, if complete erosion of the habitat mix is observed (i.e., in a contiguous area of 5,000 feet or greater) this would trigger contingency actions to replace the habitat mix.

4.2 PHYSICAL INTEGRITY EARLY ACTION WARNING LEVELS

The early action warning level for the under-pier capped areas is any observation of complete erosion of the sand cap. Similarly, the early action warning level for the Western Shoreline Habitat Bench is any observation of complete erosion of the habitat mix. For the Northeast Shoreline Sediment Cap riprap, the early action warning level is observation that erosion of the riprap is occurring. Section 9.0 describes possible response contingency measures for these early warning levels.

5.0 Physical Integrity Monitoring

Physical integrity monitoring will occur at the under-pier capped areas, the Northeast Shoreline Sediment Cap, and the Western Shoreline Habitat Bench. Visual surveys will be conducted to determine if the integrity of the cap or habitat mix has been maintained and has not changed significantly over time. Tables 5.1 through 5.3 provide details regarding the physical integrity monitoring program for these three general areas.

5.1 VISUAL MONITORING

5.1.1 Frequency

5.1.1.1 Under-pier Capped Areas

Visual monitoring by divers along transects will be used to determine if there are obvious signs of change in the under-pier caps. The monitoring schedule for these caps is summarized in Table 5.1.

A post-construction baseline visual monitoring survey will be conducted within 60 days of USEPA's acceptance of the Final OMMP, and is anticipated to occur in the fall of 2007 (Year 0). The first monitoring survey of the under-pier capped areas will be conducted at Year 1, occurring approximately 1 year following completion of the baseline survey. Assuming the baseline survey is completed in the fall of 2007, the first monitoring event would occur in the fall of 2008. The second and third monitoring surveys would occur during Years 2 and 4 following completion of the baseline survey, occurring in 2009 and 2011.

If cap materials are stable after the first three monitoring events, visual monitoring surveys will be conducted again in 5 years (at Year 9) following completion of the baseline survey (2016—assuming the baseline survey is conducted in 2007). If cap materials continue to be stable, long-term monitoring of the under-pier capped areas will be considered complete and no further routine monitoring will be required. However, if monitoring indicates that significant erosion of the under-pier cap has occurred, contingency actions will be implemented as described below in Section 9.0. USEPA can direct a different sequence of monitoring based on changed conditions at the site or EPA can direct Todd to conduct supplementary monitoring to support EPA's five-year reviews. Some under-pier capped areas may need to be monitored more frequently than other s depending on the results of the routine monitoring.

A supplemental visual monitoring survey by a diver will be completed within 60 days after an earthquake that causes liquefaction of soils or building damage, at or near the Site. Occurrence of an earthquake of magnitude 6.0 or greater in western Washington will trigger inquiry by the Port of Seattle and the City of Seattle officials as to whether local liquefaction or building damage occurred. Under-pier surveys triggered by earthquakes will occur until all the piers have been demolished and contaminated sediments beneath them have been removed.

Due to the depth of the caps in the under-pier areas, these caps are likely to be unaffected by severe storm events that may occur at the Site. No supplemental visual monitoring surveys are scheduled for the under-pier caps due to severe storms that may occur.

5.1.1.2 Northeast Shoreline Sediment Cap

It is anticipated that visual monitoring surveys by divers along a transect at the Northeast Shoreline Sediment Cap will be conducted on the same schedule and at the same time as the monitoring surveys for the under-pier caps. The monitoring schedule for the Northeast Shoreline Sediment Cap is summarized in Table 5.2. A survey of the riprap slope will begin with a baseline survey conducted in 2007 and three monitoring events will then occur during Year 1, Year 2, and Year 4 following completion of the baseline survey. Assuming the baseline survey is completed in the fall of 2007, these monitoring events would occur in the fall of 2008, 2009, and 2011.

If riprap remains in place after the first three monitoring events, a diver visual survey will be performed again in 5 years, at Year 9 following completion of the baseline survey (scheduled for 2016). If the riprap continues to remain in place, long-term monitoring of the Northeast Shoreline Sediment Cap will be considered complete and no further routine monitoring will be required. However, if monitoring indicates riprap is eroded or absent from the slope, contingency actions will be implemented as described below in Section 9.0. USEPA can direct a different sequence of monitoring based on changed conditions at the site or EPA can direct Todd to conduct supplementary monitoring to support EPA's five-year reviews.

A supplemental visual monitoring survey of the Northeast Shoreline Sediment Cap will be completed after an earthquake that causes liquefaction of soils or building damage, at or near the Site. As stated above, occurrence of an earthquake of magnitude 6.0 or greater in western Washington will trigger inquiry by the Port of Seattle and the City of Seattle officials as to whether local liquefaction or building damage occurred. This supplemental survey will occur during a low tide within 60 days of the earthquake or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner, and will consist of a visual survey of the riprap made from the shoreline. These earthquake supplemental surveys will occur throughout the lifetime of the cap.

A supplemental visual monitoring survey will also be completed following a severe storm event from a northerly direction that directly exposes the Northeast Shoreline Sediment Cap to sustained wind and wave action of an extreme magnitude. A severe storm at the Site is defined as one that equals or exceeds the design criteria for the shoreline riprap—a 25-year return period wave storm event. Based on the design criteria for the riprap, Coast & Harbor Engineering prepared a technical memorandum outlining the severe storm event criteria and a method to determine if an actual storm met the criteria, triggering monitoring at the Site. This technical memorandum is included as Appendix D. Based on their analysis, the criterion for a severe storm at the Site is one where measured sustained wind speed equals or exceeds 36.7 knots. When a large storm does occur, the procedure for determining the severity of a storm includes acquiring wind speed and direction data from the National Data Buoy Center at West Point, Washington, determining the maximum sustained wind speed in the direction of interest, and comparing the wind speeds to the severe storm wind speed criterion of 36.7 knots.

If the criterion for a severe storm is met at the Site, then a supplemental survey will occur. This survey will consist of visual observation of the riprap from the shoreline adjacent to the Northeast Shoreline Sediment Cap during a low tide within 60 days following the storm or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner. Supplemental surveys due to severe storms will occur throughout the lifetime of the cap.

5.1.1.3 Western Shoreline Habitat Bench

It is anticipated that visual monitoring surveys by divers of the habitat mix along several transects at the Western Shoreline Habitat Bench will be conducted on the same schedule and at the same time as the monitoring surveys for the under-pier caps and the Northeast Shoreline Sediment Cap. Refer to the monitoring schedule in Table 5.3. A survey of the habitat bench will be conducted during Years 1, 2, and 4 for the first three monitoring events, with the first monitoring event occurring approximately 1 year following completion of the baseline survey. Assuming the baseline survey is completed in the fall of 2007, these monitoring events would occur in the fall of 2008, 2009, and 2011.

If habitat mix remains in place after the first three monitoring events, a diver visual survey will be performed again in 5 years, at Year 9 following completion of the baseline survey (2016 assuming the baseline survey is complete in 2007). If the habitat mix continues to remain in place, long-term monitoring of the Western Shoreline Habitat Bench will be considered complete and no further monitoring will be required. However, if monitoring indicates habitat mix is absent from a significant portion of the bench, contingency actions and will be implemented as described below in Section 9.0. USEPA can direct a different sequence of monitoring based on changed conditions at the site or EPA can direct Todd to conduct supplementary monitoring to support EPA's five-year reviews.

Similar to the Northeast Shoreline Sediment Cap, a visual survey of the habitat mix from the shoreline adjacent to the habitat bench will occur during a low tide within 60 days or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner, if an earthquake occurs that causes liquefaction of soils or building damage, at or near the Site (generally an earthquake of magnitude 6.0 or greater). These earthquake supplemental surveys of the habitat mix on the habitat bench will occur throughout the lifetime of the habitat bench.

A supplemental visual monitoring survey of the habitat mix on the habitat bench will also be completed following a severe storm event from a northerly direction that directly exposes the habitat bench to sustained wind and wave action of an extreme magnitude. The habitat bench was constructed so that it is protected between a buttress fill adjacent to the Pier 4S bulkhead and armoring on the steep slope waterward of the habitat bench. The habitat bench consists of a minimum 2-foot thickness of sand and a 3-foot thickness of Type 2 Habitat Mix. The Type 2 Habitat Mix was designed for a 5-year return period wave storm event and it was anticipated that under these storm conditions the habitat mix would move around on the habitat bench, but not necessarily be transported off of the habitat bench. It was determined that a 25-year return period wave storm event would be considered a severe storm for the habitat bench, similar to the Northeast Shoreline Sediment Cap. A storm of this magnitude would likely result in a significant loss of the habitat mix from the habitat bench. As stated above in Section 5.1.1.2, a 25-year return period wave storm at the Site corresponds to a storm where the measured sustained wind speed equals or exceeds 36.7 knots. The detailed procedures for determining

whether an actual storm at the Site meets or exceeds this criterion are included in Appendix D and are summarized in Section 5.1.1.2.

If the criterion for a severe storm is met at the Site, a supplemental survey of the habitat bench will be triggered and will consist of a visual observation of the habitat mix from the shoreline adjacent to the habitat bench during a low tide within 60 days following the severe storm or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner. Supplemental surveys due to severe storms will occur throughout the lifetime of the habitat bench.

5.1.2 Methods

5.1.2.1 Under-pier Capped Areas

Under-pier cap monitoring for Piers 1A, 1, 2P, 3, 4N, 5, 6, and 6P and monitoring within the over-water areas of the building berth will be performed using diver surveys. Survey methods to be employed are similar to the methods developed during remedial action construction to conduct quality assurance of the under-pier caps. During construction several methods of measurement and monitoring were conducted and it was determined by USEPA and Todd that diver surveys were the only consistently reliable and effective method of assuring the quality of the under-pier caps.

Transect Locations

Under-pier cap monitoring will take place along 17 specific transects, at the locations shown in Figure 3.1. The number and location of transects were selected to provide a systematic and spatially diverse representation of under-pier conditions throughout the shipyard. It is understood that the shipyard is a dynamic facility and that over the life of the under-pier caps a variety of activities and operations will likely take place at each of the piers and that a variety of potential forces (e.g., vessel wake, dry dock operation, propwash, and/or storm surges) will potentially act on each of the under-pier caps. Additionally, the types of ships serviced and the frequency and location of these ships at the shipyard varies and it is difficult to anticipate the areas of propwash at the piers. Transects will be made perpendicular to the pier face rather than along the side or down the middle of the pier, so that the sand depths under the piers (as well as 10 feet waterward from the face of the pier, where capping occurred) are visually examined. The 17 transect locations identified on Figure 3.1 for the under-pier areas will facilitate a broad overview of how well the under-pier caps are performing throughout the shipyard.

Baseline Survey

A baseline diver survey will be conducted to visually document initial coverage of the under-pier sand cap areas. Baseline surveys will be conducted along each of the transect locations shown in Figure 3.1. Long-term physical integrity monitoring survey results, discussed below, will be compared to the results of the baseline survey to evaluate if there is erosion of under-pier caps over time.

In preparation for the baseline survey the diver will place a flexible fiberglass measuring tape along each pre-selected transect. The 0–foot line on the tape will be placed 10 feet waterward of the face of the pier and the tape will extend underneath the pier either to the point near the top of the slope (approximately 0 feet MLLW) where cap material was not placed and riprap is exposed (at Piers 1A, 1, 2P, and 3) or to a point 10 feet past the opposite pier face (at Piers 4N, 5, and 6).

The diver will then swim the transect line carefully, continuously observing the substrate type and coverage. An underwater audio/video recording will be produced documenting the diver's observations and real-time comments along each transect. Detailed diver observations and comments will be made at 10-foot increments along each transect, and will include a determination of whether the substrate is sand cap material (coarse- to medium-grained sand), recently deposited sediment overlying the cap, or sediment that was previously capped but uncovered due to erosion or downslope movement of the cap material. If the cap material is covered with recent sediment deposits, the diver will use a sampling spoon to uncover and document the presence of cap material. Two surface samples of the in-place cap material will be collected from each transect using 10 cm diver cores. These samples will be tested to determine the grain-size distribution of the cap material for future comparison with long-term survey results, as discussed below. Survey and sampling methods will be performed very carefully so as to minimize disturbance of the cap.

Long-term Monitoring Surveys

Physical integrity visual monitoring will be conducted by diver surveys, performed over time to assess and document coverage of the under-pier cap areas. Diver surveys will be performed along the same transects used for the baseline survey (Figure 3.1) using the same techniques discussed for the baseline survey. If the diver is unable to visually determine and document the substrate type at any of the 10-foot monitoring stations along the transects, a surface sample will be collected and a grain-size analysis performed to determine whether or not the material is similar to the sand used for capping (as demonstrated by a comparison to the grain-size distribution of cap materials performed during the baseline survey).

If diver survey results reveal erosion of capped areas that expose underlying sediments, contingency actions will be performed to address the eroded area, as discussed below in Section 9.0.

Supplemental Monitoring Surveys

Supplemental visual monitoring surveys will be conducted for the under-pier cap areas in the event of an earthquake that causes liquefaction of soils or building damage, at or near the Site (as discussed in Section 5.1.1.1). Diver surveys will be performed along the same transects and using the same techniques discussed above for these long-term monitoring surveys. If the sand cap is noted to be absent in an under-pier area during these visual diver surveys, additional transects will be surveyed to delineate the extent of the loss in the areas where complete erosion of the cap is observed. Contingency actions will then be implemented as discussed in Section 9.0.

5.1.2.2 Northeast Shoreline Sediment Cap

Physical integrity visual monitoring of the Northeast Shoreline Sediment Cap will be performed to determine whether the cap armoring remains in place over time. This monitoring will consist of a baseline visual survey and follow-on long-term monitoring visual surveys along a transect perpendicular to the shoreline across the cap area (Figure 3.1). Additionally, supplemental visual monitoring surveys of the sediment cap may be required due to earthquakes or severe storms as discussed in Section 5.1.1.2.

Due to the size and weight of riprap placed on the slope in the Northeast Shoreline Sediment Cap area and the potential erosive forces that may act on the slope, it is highly unlikely that cap erosion will occur. In addition, Todd has implemented institutional controls that prevent future disturbance of the cap area.

Baseline and Long-term Monitoring Surveys

Baseline and long-term visual monitoring along the Northeast Shoreline Sediment Cap transect will be accomplished both above and below the water because the capped area extends from approximately +17-feet MLLW to –40-feet MLLW. Procedures for the cap monitoring surveys are similar to the baseline and long-term monitoring surveys to be accomplished for the under-pier caps discussed in Section 5.1.2.1. The diver/surveyor will observe the substrate conditions along the transect to verify the presence of riprap and an audio/video recording will be produced that documents the conditions of the substrate along the transect during the survey. Detailed diver observations and comments will be made at every 10-foot increment along the transect. No surface samples of material will be collected during the visual monitoring of the riprap.

If riprap has eroded or is not observed over a portion of the transect, additional transects will be surveyed to delineate the extent of the slope where riprap is eroded or absent. If riprap is eroded or absent, contingency actions will be performed, as discussed in Section 9.0.

Supplemental Monitoring Surveys

Supplemental visual monitoring surveys will be conducted on the Northeast Shoreline Sediment Cap for large earthquakes and severe storms. The definitions of a large earthquake and severe storm that would trigger these supplemental surveys are included above in Section 5.1.1.2. A supplemental survey will consist of a visual survey of the riprap made from the shoreline during low tide. If an adequate visual survey of the riprap from the shoreline cannot be made during low tide, then the visual survey will be completed by a diver using the same procedures described above for the baseline and long-term monitoring surveys. If riprap is noted to be eroded or absent in the capped area during this visual shoreline survey or the diver transect survey, diver visual transects will then be made to delineate the extent of the riprap loss. Contingency actions will then be implemented as described in Section 9.0.

5.1.2.3 Western Shoreline Habitat Bench

Physical integrity visual monitoring of the Western Shoreline Habitat Bench will be performed to determine whether the habitat mix material remains in place over time. This monitoring will consist of a baseline survey and follow-on physical integrity monitoring surveys along three

transects perpendicular to the shoreline across the habitat bench (Figure 3.1). Additionally, supplemental visual monitoring surveys of the Habitat Bench may be required due to earthquakes or severe storms as defined in Section 5.1.1.3.

It is anticipated that because the grain-size distribution of the Type 2 Habitat Mix was determined based on a site-specific study that it will remain stable despite the erosive wave forces acting on this area of the site.

Baseline and Long-term Monitoring Surveys

Baseline and long-term visual monitoring along the Western Shoreline Habitat Bench will be accomplished using procedures similar to those used for the under-pier caps discussed in Section 5.1.2.1. The diver will observe the substrate conditions along the transects to verify the presence of habitat mix and an audio/video recording will be produced that documents the conditions of the substrate on the habitat bench during the survey. Detailed diver observations and comments will be made at every 10-foot increment along each transect. No surface samples of material will be collected during the visual monitoring of the habitat mix.

If habitat mix is completely eroded over a portion of one of the transects, additional transects will be surveyed to delineate the extent of the bench where habitat mix material is absent. If habitat mix is completely eroded on a portion of the bench, contingency actions will be performed, as discussed in Section 9.0.

Supplemental Monitoring Surveys

Similar to the Northeast Shoreline Sediment Cap, supplemental visual monitoring surveys will be conducted on the Western Shoreline Habitat Bench for large earthquakes and severe storms. The definitions of a large earthquake and severe storm that would trigger these supplemental surveys are included above for the habitat bench in Section 5.1.1.3. A supplemental survey will consist of a visual survey of the habitat mix from the shoreline during a low tide adjacent to the habitat bench, preferably a tide which is at or below elevation -2 feet MLLW. If an adequate visual survey of the habitat mix from the shoreline cannot be made during low tide, then a visual survey will be conducted by a diver along the three transects shown in Figure 3.1 using the same procedures described above for the baseline and long-term monitoring surveys. If the habitat mix is noted to be absent in areas of the habitat bench during this visual shoreline survey or the diver transect survey, diver visual transects will then be made to delineate the extent of the area where complete erosion of the habitat mix loss has occurred. Contingency actions will then be implemented as described in Section 9.0.

5.2 DATA ANALYSIS

During the baseline survey of the under-pier capped areas, two surface samples of the in-place cap material will be collected from each of the 17 transects, as discussed above in Section 5.1.2.1. Grain-size analyses will be performed on these baseline samples. Additional surface samples may also be collected from the under-pier capped area transects during the long-term monitoring surveys if the diver is unable to visually determine and document the substrate type along the transects. Grain-size analyses would also be performed on these long-term monitoring surface samples. The grain-size distribution results for the long-term monitoring

surface samples would be compared to the appropriate baseline transect sample grain-size distribution results to determine whether or not the material is similar to the sand used for capping or whether erosion of the sand cap has occurred. If cap erosion has occurred, contingency actions will be implemented (refer to Section 9.0).

Summaries of the visual inspections made for the under-pier capped areas, the Northeast Shoreline Sediment Cap, and the Western Shoreline Habitat Bench will be prepared and included in monitoring reports as discussed in Section 8.0. Comparisons to previous visual survey observations will be documented in these reports.

6.0 Institutional Controls and Best Management Practices

Institutional controls will be implemented at TSSOU to prohibit activities that would disturb the capped areas, including the Northeast Shoreline East Area Sediment Cap, the under-pier capped areas, and the Western Shoreline Habitat Bench and to ensure that these areas are maintained over their lifetime. The areas of the Site where institutional controls are applicable are illustrated on Figure 6.1. Survey benchmarks for the Site are shown on Figure 6.2, which has been stamped by David Evans and Associates, Inc.

6.1 NORTHEAST SHORELINE SEDIMENT CAP

The sediment cap in the Northeast Shoreline Area covers 0.34-acres. Todd has created a process memorandum describing the institutional controls for this sediment cap area, which describes how this area will be monitored and maintained over time. This process memorandum is included as Appendix E. Todd's process memorandums define the procedures and restrictions that must be met for all operations throughout the Shipyard. The process memorandums are very tightly controlled, and are posted on Todd's intranet. Approval to remove or modify the Northeast Shoreline Sediment Cap Institutional Controls process memorandum is limited to Todd's General Counsel (the position currently held by Mike Marsh).

Todd will maintain the Northeast Shoreline Sediment Cap area in perpetuity, unless approval is received from both USEPA and Todd's General Counsel to cease maintenance. Long-term periodic monitoring will be required for this area to ensure that the slope is stable and riprap remains in place, as described in Section 5.0. Response actions are required if long-term performance standards or early action warning levels are exceeded, as summarized in Section 9.0. In addition, Todd will not excavate or dredge within this area without USEPA approval and appropriate planning.

6.2 WESTERN SHORELINE HABITAT BENCH

The habitat bench along the western shoreline covers 0.47-acres. Similar to the Northeast Shoreline Sediment Cap area, Todd has created a process memorandum describing the institutional controls for the Western Shoreline Habitat Bench, which describes how this area will be monitored and maintained over time. This process memorandum is included as Appendix F. Approval to remove or modify the Western Shoreline Habitat Bench Institutional Controls process memorandum from Todd's intranet is limited to Todd's General Counsel (the position currently held by Mike Marsh).

The shoreline habitat bench is not a CERCLA required element of the project. It was constructed to provide habitat restoration that could be utilized in a future Natural Resource Damage (NRD) Settlement with the NRD Trustees. Todd intends to maintain this area in perpetuity, and to perform long-term periodic monitoring to ensure continued presence of habitat mix materials, as discussed in Section 5.0. Response actions are required if long-term performance standards or early action warning levels are exceeded, as summarized in Section 9.0. These commitments will be confirmed with the NRD Trustees as part of future settlement negotiations.

6.3 UNDER-PIER CAPPED AREAS

Under-pier capped areas include Piers 1A, 1, 2P, 3, 4N, 5, 6, and 6P and within the over-water areas of the building berth. An institutional control process memorandum for the under-pier capped areas has also been created by Todd (refer to Appendix G). This memorandum describes how these under-pier capped areas will be monitored and maintained over time and also describes Todd's obligation to remove contamination located in an under-pier area when Todd removes or replaces a pier at the end of the pier's service life. Approval to remove or modify the Under-pier Sediment Caps Institutional Controls process memorandum from Todd's intranet is limited to Todd's General Counsel (the position currently held by Mike Marsh).

While the piers are in use, long-term physical integrity monitoring surveys will occur beneath the piers to ensure the caps remain in place (refer to Section 5.0) and contingency actions will be implemented in the event that there is evidence of significant cap erosion (refer to Section 9.0). In addition, Todd will not excavate or dredge within this area without USEPA approval and appropriate planning. To prevent or minimize erosion of the under-pier caps, BMPs will be implemented requiring ships operating adjacent to the piers to restrict engine power to minimum levels and for tugs not to operate such that propwash is directed toward the caps. These BMPs are outlined in Todd's process memorandum called Propeller and Rudder Turning (refer to Appendix H).

When the existing pier structures reach the end of their serviceable capacity and are demolished, under-pier sediment will be dredged for permanent cleanup. A pier structure is determined to be at the end of its serviceable capacity when it is condemned for use by heavy industrial vehicular traffic, such as fire truck access. When a pier is condemned, demolition and cleanup will begin within one year following condemnation and will be completed within three years following condemnation. After permanent cleanup has been completed in an under-pier area, the site OMMP will be amended (refer to Section 11.0) as the under-pier monitoring or maintenance in that area will no longer be required.

7.0 Long-term Effectiveness of Source Control Actions

7.1 STORMWATER SOURCE CONTROL

Discharges from Todd's operations to adjacent surface waters are regulated and permitted by Ecology under the NPDES Waste Discharge Permit No. WA-000261-5 (Ecology 2004), which was originally issued in 2002 but modified in February 2004 to include provisions for the newly constructed contaminated industrial stormwater collection and treatment system. Todd's modified 2002 NPDES permit contains final maximum daily effluent standards for turbidity, total suspended solids (TSS), oil and grease, and total recoverable copper, lead, and zinc for stormwater discharges from the emergency overflow (Outfall OA) for the contaminated industrial stormwater collection and treatment system. An updated NPDES permit is scheduled to be issued to Todd in the fall of 2007.

An analysis of all known, available and reasonable methods of prevention, control, and treatment (AKART) of contaminated stormwater was completed in 1998 (FSM 2003b). This document identified collection and discharge to the sanitary sewer for treatment at the King County treatment plant as the preferred treatment alternative for Todd stormwater. This was determined to be the most reliable alternative to allow Todd to consistently meet the final effluent limits required by the NPDES permit. A new contaminated industrial stormwater collection and treatment system was constructed by December 31, 2003, as required by Todd's NPDES permit.

The area of Todd served by the contaminated industrial stormwater collection and treatment system consists of Drainage Basins 4 and 5 (for the purpose of complying with NPDES permit conditions) as well as Drainage Basins 0, 1, 2, 3, 20, and 23 (refer to Figure 2.1 of the Final Source Control Report; FSM 2003b). These additional drainage basins previously discharged stormwater through Outfalls 0A, 0C, 0D, 0E, and 20. In total, approximately 15 acres of the Todd facility, representing all primary areas where industrial activities occur, are serviced by the new contaminated industrial stormwater collection and treatment system.

The contaminated industrial stormwater collection and treatment system is diagrammed in Figures 7.1 and 7.2. The system consists of the following components:

- Separation of roof and employee parking lot stormwater, as required by federal and local criteria, for direct discharge to surface waters.
- Collection and conveyance of industrial yard pavement runoff to on-site detention, including primary solids removal at catch basin sumps and secondary solids removal, and oil and grease separation, in "StormCeptor" devices prior to entering on-site pump stations.
- On-site detention for a 10-year design storm storage volume split between three detention tanks, including tertiary solids removal in a detention tank sump.
- Detention tank configuration allowing detention and isolation of a 10-year storm volume, including the first flush of stormwater, which carries the majority of industrial yard contaminants.

- During events greater than a 10-year storm, on-site puddling will be allowed until such time as the puddles are observed to pose a danger to equipment and/or the health and safety of workers, or are observed to be in danger of flowing over the edge of the facility into surface waters. When this occurs, a manually-operated emergency overflow to Elliott Bay via existing Outfall OA will be utilized.
- Metered discharge from detention to the Seattle Public Utilities (SPU) sanitary sewer at controlled flow rates in order to maintain a total maximum sanitary discharge from the Todd property (based upon available capacity in the SPU sanitary system on Harbor Island, given SPU current and potential future sanitary sewer inflows from other customers).
- Emergency shutoff at the point of discharge to the SPU sanitary sewer in the event of an emergency requiring discharge control in coordination with SPU.
- Final treatment at the King County Publicly Owned Treatment Works (POTW).

7.1.1 Stormwater Collection and Treatment System Overflow Monitoring

System overflows are anticipated to occur less than once every 10 years. For the purpose of source control and measuring the long-term effectiveness of the remedy, overflows from the contaminated stormwater collection and treatment system will be monitored for sediment COCs and NPDES parameters, as described below.

Samples of the overflow water will be taken during the first hour after the emergency overflow valve is opened. Samples will be collected from a sampling spigot located in the overflow valve manhole, upstream of the outfall (Figure 7.2).

Stormwater collection and treatment system overflow samples will be collected and tested for NPDES parameters (turbidity, TSS, oil and grease, and total recoverable copper, lead, and zinc) following NPDES analytical requirements. Additionally, samples will be collected and analyzed for sediment COCs (PCBs, PAHs, tributyltin, arsenic, copper, lead, zinc and mercury) following the sampling, analytical, and quality control procedures described in the RASAP and QAPP (Appendix B of the RAWP; FSM 2004a) for water quality samples, with two exceptions:

1. All sediment COCs (aside from TBT) will be analyzed for both total/recoverable and dissolved fractions. TBT will only be analyzed for total TBT.
2. The analytical method for PAHs will be USEPA 8270 SIM with a reporting limit of 0.1 parts per billion (ppb) for each PAH.

Stormwater collection and treatment system overflow monitoring results will be submitted to USEPA following the reporting schedule described in Section 8.0. The results of overflow monitoring will also be submitted to Ecology, as part of reporting requirements for the NPDES permit.

7.1.2 Stormwater Collection and Treatment System Maintenance

Maintenance of the contaminated industrial stormwater collection and treatment system is performed in accordance with the system's operations and maintenance manual, submitted to Ecology in March 2004 (FSM Team 2004b).

7.2 DRY DOCK GRIT MANAGEMENT SOURCE CONTROL

In addition to stormwater discharges, Todd's NPDES permit regulates dry dock floodwater discharges, and removal of grit from the dry dock surfaces prior to submergence. The NPDES permit states that the dry docks shall be free of debris prior to flooding the dry dock:

> "The dry dock shall be cleaned of spent sand blast grit and debris prior to launching a vessel. Cleaning shall be accomplished with manual or mechanical sweeping with vacuuming to remove fine grit and debris" (Ecology 2004).

The NPDES permit contains final maximum daily effluent limits for dry dock discharges for oil and grease; turbidity (of discharge); and background turbidity (of receiving water). In addition, the NPDES permit requires photo documentation of grit removal activities.

Grit removal from the dry docks prior to submergence additionally meets USEPA source control requirements. Todd has developed upgraded grit management procedures to maximize the effectiveness of grit removal from the dry docks prior to submergence, minimize contact of spent grit with precipitation and surface water by updating storage and transportation procedures, as well as decontamination procedures for forklifts and dry docks. This management plan is included in the final Source Control Report (FSM 2003b) and has been incorporated into the standard practices at Todd (Todd Shipyards Stormwater Pollution Prevention Plan [SWPPP; FSM 2004b] and Todd Shipyards Process Memorandums [Todd 2003]).

7.2.1 Monitoring of Dry Dock Discharge

The testing schedule and sampling method for dry dock discharges are described in Todd's NPDES permit (Ecology 2004). For the purposes of sediment source control, NPDES monitoring requirements for dry dock discharges must be met and analyses results submitted to Ecology, according to NPDES requirements, and to USEPA, according to the reporting schedule described in Section 8.0.

In accordance with NPDES, samples are collected once per month at each dry dock. Grab samples are taken at the water surface as the dry dock is lowered to launch the vessel when the water is between 3 and 6 feet above the dry dock deck. The sampling location is in line with the end of the wingwall and approximately 5 feet out from the wingwall. Background turbidity samples are taken from the apron of the dry dock within 1 hour prior to flooding the dry dock or at another time and location agreed to by Ecology (Ecology 2004).

Additionally, as part of the NPDES permit compliance process the condition of every dry dock floor prior to launching a vessel is photographed. Dry dock photographs are maintained in a logbook at Todd along with the name of the vessel, dry dock number, the date the vessel was launched, the date the photograph was taken, and the name of the photographer. This logbook can be made available to Ecology and USEPA representatives, as requested.

Dry dock discharge monitoring requirements will be updated in an updated NPDES permit for Todd, scheduled to be issued in the fall of 2007. These requirements will likely add some sediment sampling to confirm that dry dock discharges are not impacting sediment quality in concentrations greater than acceptable limits.

7.2.2 Dry Dock Grit Management Maintenance

Dry dock grit management maintenance is related to the implementation of BMPs. BMPs at Todd are implemented through several programs. Good housekeeping practices are encouraged by the facility-wide "5S" Program. Todd's BMP Plan and Process Memoranda (filed at Todd; Todd 2003), which are part of the Todd Quality System Documentation system, are based on requirements of programs similar to those of the USEPA, RCRA, U.S. Coast Guard, and NPDES Waste Discharge Permit. The Spill Prevention Control and Countermeasure Plan (SPCC) and Operations Manual for Oil and Sludge Transfer from Vessels (Todd 2002), filed at Todd, describe operating procedures that minimize the danger of surface water contamination during refueling operations and the transfer of oil or sludge from vessels undergoing construction, conversion, or repair. The Todd SWPPP (FSM 2004b), filed with Ecology, compiles the facility's BMPs with a specific focus on preventing stormwater pollution.

8.0 Documentation and Reporting Schedule

This section provides the reporting schedule for long-term monitoring activities discussed in the previous sections. A schedule of the routine OMMP monitoring activities and reporting to occur over the next nine years is included in Table 8.1.

8.1 REPORTING FOR PHYSICAL INTEGRITY MONITORING

Draft reports for the baseline and routine long-term physical integrity monitoring surveys will be submitted to USEPA within 45 days after completion of the survey. The actual delivery data may be modified based on approval by USEPA in the event that additional sediment sampling or other contingency response actions become necessary. Final reports will be submitted pending USEPA's review 45 days after receipt and resolution of USEPA comments.

These reports will include an audio/video record documenting the visual observations and real-time comments made during the diver survey. For sediment samples collected for grain-size analysis along the transects, a summary of field sampling activities and the samples collected will be included in the report, along with field sampling logs, a figure showing sample locations, tabulated grain-size analysis results, and the laboratory analysis reports. Each report will also include a written evaluation of the data and provide comparisons to previous visual survey observations and grain-size analysis results. Each report will also identify whether contingency actions are warranted in any of the monitored areas, per the performance standards and early warning levels defined in Section 4.0.

8.1.1 Reporting for Severe Storm/Earthquake Physical Integrity Monitoring

After a severe storm event or earthquake, as defined above in Section 5.0, a supplemental physical integrity monitoring inspection will be completed and a report will be submitted to USEPA within 45 days after the monitoring event has been completed. Reports will be similar in format and content to the routine physical integrity monitoring reports described above.

8.2 REPORTING FOR STORMWATER OVERFLOW MONITORING

An overflow event from the on-site contaminated industrial stormwater collection and treatment system is anticipated to occur less than once every 10 years. Overflow quality will be monitored as described in Section 7.1.1, when an overflow event occurs. Results from overflow monitoring will be submitted to USEPA within 60 days of an overflow event for each overflow event that occurs within 10 years following the completion of the remedial action.

8.3 REPORTING FOR DRY DOCK DISCHARGE MONITORING

Routine dry dock discharge monitoring under NPDES will occur monthly and is described in detail in Section 7.2.1. The results of dry dock discharge monitoring will be summarized in an annual report to be submitted to USEPA within 30 days of the close of the calendar year for 5 years after the completion of the remedial action. Each annual report will summarize discharges for the previous calendar year.

8.4 U.S. ENVIRONMENTAL PROTECTION AGENCY FIVE-YEAR REVIEWS

The USEPA conducts five-year reviews at sites when hazardous substances, pollutants, or contaminants remain on-site in concentrations greater than that which allows for unlimited use and unrestricted exposure. The primary purpose of a five-year review is to determine whether the cleanup continues to be protective of human health and the environment and whether additional monitoring is required based on previous monitoring results and the remedy itself. USEPA can direct or perform supplementary monitoring to support their five-year review process. This monitoring can include physical or chemical monitoring of the dredged or capped areas.

9.0 Contingency Planning and Response

In the event that physical integrity monitoring of the under-pier capped areas, the Northeast Shoreline Sediment Cap, or the Western Shoreline Habitat Bench indicates that performance standards are not being met, or that early action warning levels are being exceeded (refer to Section 4.0), Todd shall implement the contingency process summarized in this section.

9.1 CONTINGENCY SCREENING

Contingency screening is initiated by an exceedance of the physical integrity performance standards or early action warning levels. There is an exceedance of the early action warning levels if visual monitoring results show any areas with complete erosion of the under-pier sand cap or complete erosion of the habitat mix on the Western Shoreline Habitat Bench. Any observed erosion of the riprap on the Northeast Shoreline Sediment Cap would be an exceedance of an early action warning level. If a contiguous area of complete erosion of the under-pier sand caps or the habitat mix that is equal to or greater than 5,000 square feet is observed, then there is a performance standard exceedance. Complete erosion of the riprap on the Northeast Shoreline Sediment Cap in any area would exceed the performance standard for this capped area.

The initial contingency screening action will be to delineate the area of concern and extent of erosion by conducting additional diver transects and by comparing the results of the survey to the baseline and previous survey events. The delineation of the extent of the impacted area will occur during the monitoring surveys if possible. If performance standards or early action warning level exceedances occur Todd will notify USEPA within 15 days and provide USEPA written documentation within 30 days of receipt of the preliminary field survey observations or grain-size analysis data. Draft summary documentation of the conditions will be forwarded to USEPA as part of the notification process.

Following notification, Todd will discuss the monitoring results and initial contingency screening results with USEPA to determine whether further data verification may be necessary (e.g., additional delineation, resampling, or other response actions) to further determine the extent of the affected area. Additional delineation could include additional diver transects of the area. Additional sediment samples may also be collected for grain-size analysis for comparison to baseline samples. This additional data will be forwarded to USEPA within 30 days of receipt.

USEPA may also determine that no additional data verification is needed to proceed to the contingency planning stage.

9.2 CONTINGENCY PLANNING

This section summarizes the contingency planning that would occur to determine the appropriate contingency response to be implemented. Table 9.1 provides potential contingency actions that would be taken if there are early action warning level or performance standard exceedances.

9.2.1 Evaluating Causes of Erosion

If there are observed exceedances of early action warning levels and/or the performance standards, a plan will be put in place to evaluate the cause of erosion in the areas identified. The possible causes of erosion will be evaluated based on the survey data relative to the baseline survey, any previous monitoring survey events, and available information about local vessel activity or storm events. Patterns of erosion and deposition will be visually analyzed. Three possible causes of erosion are identified as:

1. Localized propwash
2. Movement of cap material down-slope due to slumping after placement on steep slopes
3. Area-wide erosion due to wave action and/or natural hydrodynamics

Identification of the likely cause of the erosion will affect decision making about potential propwash controls and material replacement.

If it is determined that the erosion was likely caused by propwash action or other shipyard operations, Todd will determine whether that situation is likely to be repeated, and whether there are additional operational controls governing propwash or operational BMPs that could be established to control erosion in the subject area. Documentation of this evaluation and its resultant recommendation will be provided to the USEPA.

9.2.2 Contingency Action Planning

If there is an observed exceedance of a performance standard, Todd will submit a Contingency Action Planning Report to USEPA describing plans and contingency response actions to be taken to address any fully eroded riprap areas on the Northeast Shoreline Sediment Cap, or any fully eroded areas exceeding greater than 5,000 contiguous square feet of the under-pier sediment cap or the habitat mix on the habitat bench. Performance standard exceedances in the under-pier areas may also trigger Todd to conduct additional sediment evaluations and sampling in these areas, as discussed below in Sections 9.2.2.2 and 9.2.2.3.

The need for further sampling and analysis of the Northeast Shoreline Sediment Cap area, the Western Shoreline Habitat Bench, and/or adjacent areas will be determined in conjunction with USEPA.

9.2.2.1 Contingency Action Planning Report

Todd will submit a Contingency Action Planning Report to USEPA within 60 days of the submittal of the Physical Integrity Monitoring Report. The Contingency Action Planning Report will include the following:

1. Evaluation of extent of erosion in area of concern, and erosion trends in adjacent areas
2. Evaluation of cause of erosion

3. Proposed material replacement and operational controls if it is determined that erosion has been caused by propwash or other operational effects
4. Material replacement plan, including a proposed schedule for implementation
5. Adjusted monitoring schedules (including an adjusted monitoring schedule in the area of concern, and a schedule for future routine monitoring)

If the performance standard exceedance occurs in the under-pier capped area, the report will also include under-pier chemical sampling results and associated mapping, if sampling was conducted (refer to Section 9.2.2.2 below). Proposed sampling locations for chemical sampling of open-water areas adjacent to under-pier areas, if proposed, will also be included in the report (refer to Section 9.2.2.3 below).

If additional sediment sampling is determined to be necessary for the Northeast Shoreline Sediment Cap area, the Western Shoreline Habitat Bench, and/or adjacent areas based on discussion with USEPA, then either sampling results will be included or sampling locations and methods will be proposed in the Contingency Action Planning Report.

Based on review of the Contingency Action Planning Report, USEPA and Todd will define, document, and schedule any additional sampling to occur and the contingency response to be performed.

9.2.2.2 Chemical Sampling of Under-pier Area Underlying Sediments

If complete erosion of the sand cap material over a contiguous 5,000-square-foot area is observed in the under-pier area, Todd may collect surface samples of the underlying sediment. These underlying sediment samples would be analyzed for all COCs in accordance with the procedure and frequency requirements described in the Appendix I Sampling and Analysis Plan (SAP) and QAPP.

If the underlying sediment does not exceed the cleanup criteria, listed in Table 1.1, material replacement is not required, and chemical sampling of adjacent open-water areas will not be performed. If underlying sediments are determined to contain COCs at concentrations exceeding the cleanup criteria, then cap material will be replaced, to the extent feasible, to the average cap thicknesses specified in the remedial action design, and chemical sampling of adjacent open-water areas will be performed.

9.2.2.3 Chemical Sampling of Open-water Area Sediments Adjacent to the Under-pier Areas

If complete erosion of the sand cap material is identified over a contiguous 5,000-square-foot area and contamination exceeding the cleanup criteria is also identified in the exposed under-pier sediments, chemical sampling of adjacent sediment in the open-water areas will be required. Sampling will be performed to determine whether erosion of under-pier sediments has caused recontamination of the sediments in the adjacent open-water areas.

If sampling of sediment in the open-water areas is determined to be necessary, Todd will prepare a map of proposed sediment sampling locations to include in the Contingency Action Planning Report, and will obtain USEPA's approval prior to collecting sediment samples. The

sampling locations will be representative of the open-water bathymetry immediately adjacent to the area of complete erosion of under-pier cap material. Samples will be collected and analyzed in accordance with the procedure and frequency requirements described in the Appendix I of the SAP and QAPP or in accordance with procedures acceptable to USEPA.

If, through the procedures defined above, it is determined that erosion of under-pier sediments has caused recontamination of adjacent open-water areas at levels of concern, contingency actions for remediation of the sediment in the open-water areas will be proposed and negotiated with USEPA.

9.2.2.4 Under-pier Material Replacement

The need for and feasibility of installing replacement of the sand cap in the under-pier areas will be determined based on the cause of erosion and results of chemical sampling performed on the underlying sediments, as summarized below:

1. If it is determined that erosion was caused by propwash, and if chemical sampling is performed that indicates exceedances of cleanup criteria, the cap material will be replaced, to the extent feasible, to the average cap thickness specified in the remedial action design.
2. If it is determined that the erosion was caused by down-slope movement due to slumping, the pattern of slumping (both deposition and reduction) will be analyzed to determine the feasibility and effectiveness of additional material placement. Documentation of this analysis and its resultant recommendation will be provided to the USEPA in the Contingency Action Planning Report. Additionally, the results of optional chemical sampling of underlying sediments will be evaluated to establish whether cap replacement is necessary.
3. If it is determined that the erosion was caused by wave action or other natural hydrodynamics Todd may choose to replace the eroded cap material, or perform chemical sampling of the underlying sediments to determine whether chemical concentrations in sediments are present at levels of concern that would require capping. If natural patterns of erosion are identified as the cause, the area may not contain any depositions of contaminated material requiring capping. If chemical concentrations in sediments are present in concentrations exceeding cleanup levels, cap material will be replaced, to the extent feasible, to the average cap thickness specified in the remedial action design. Documentation of this analysis and its resultant recommendation will be provided to the USEPA in the Contingency Action Planning Report.

9.3 CONTINGENCY RESPONSE

Following USEPA approval of the Contingency Action Planning Report, Todd will implement the agreed-upon actions. This will include agreement on a final implementation schedule, follow-up contingency actions and related confirmation monitoring, and report/documentation.

9.4 ADJUSTED MONITORING SCHEDULE FOLLOWING CONTINGENCY RESPONSE

In areas where eroded material is replaced, a new baseline survey will be performed and the frequency of monitoring will be increased. Monitoring of the area will be conducted at Year 1 and Year 2 following replacement. If cap materials are stable after these two additional monitoring events, physical integrity monitoring surveys in this area will be conducted as part of the routine monitoring schedule, described in Section 5.1.

10.0 Monitoring Frequency Reduction Request Procedures

Results from each monitoring event will be analyzed, prepared in report format, and submitted to USEPA for review. If stable conditions are reported over the 9 years long-term monitoring is scheduled to occur at the Site, then Todd will request that no further routine long-term monitoring be required. In consultation with Todd, USEPA will determine when monitoring can be abbreviated or ceased. USEPA can direct a different sequence of monitoring based on changed conditions at the site or EPA can direct Todd to conduct supplementary monitoring to support USEPA's five-year reviews. Supplemental monitoring events due to earthquakes would still occur past 10 years for the under-pier capped areas, the Northeast Shoreline Sediment Cap, and the Western Shoreline Sediment Bench. Severe storms would also still trigger supplemental monitoring events for the Northeast Shoreline Sediment Cap and the Western Shoreline Sediment Bench after 10 years.

11.0 Amendments to the OMMP

This OMMP may be revised contingent on USEPA approval. The following are examples of events that may results in a revision to the OMMP:

- Administrative changes
- Change in Site conditions (e.g., demolition of a pier and cleanup of the under-pier area)
- Improvements
- Availability of more efficient methodology or equipment

If modifications to this document are deemed necessary during development and implementation of the project activities, then the appropriate modifications to sections and procedures will be made. Amendments will be written and incorporated into this document. Amendments will be noted by the revision number and by the date. Amendments to this document will be approved by USEPA, prior to implementing changes. The revised pages of the OMMP will be accompanied by a letter describing insertion and removal of the changes, as appropriate. The table of contents of this document will be updated to reflect amendments, as appropriate.

12.0 Standard Operating Procedures

Standard operation procedures (SOPs) that will be used for the physical integrity monitoring required for determining the continued presence of capped materials on the under-pier sediment caps, the riprap on the Northeast Shoreline Sediment Cap, and the Western Shoreline Habitat Bench are included in Appendix I. This appendix includes both the SAP and the QAPP. Contingency planning, as discussed in Section 9.0, may require the collection of sediment for analysis of the Site's COCs; therefore, this is also covered in the Appendix I SOPs.

All work performed on-site will be performed in accordance with a Health and Safety Plan (HSP), Appendix C of the RAWP (FSM 2004a), that meets the Remedial Action SOW requirements for an HSP. Contractors and consultants performing site work under the OMMP will be required to prepare project-specific HSPs specific to the scopes of work being performed. HSPs will meet Remedial Action SOW requirements.

13.0 References

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Table 1.1
TSSOU Cleanup Standards and West Waterway Confirmational Numbers

Chemical of Concern	Units	SQS Cleanup Criteria[1]	West Waterway Confirmational Numbers[2]
Arsenic	mg/kg	57	93
Copper	mg/kg	390	390
Lead	mg/kg	450	530
Mercury	mg/kg	0.41	1.34
Zinc	mg/kg	410	960
PCBs	mg/kg-OC	12	39
PCBs	µg/kg	130[3]	591[3]
LPAHs[4]	mg/kg-OC	370	780
LPAHs	µg/kg	5,200[3]	13,000[3]
HPAHs[5]	mg/kg-OC	960	5,300
HPAHs	µg/kg	12,000[3]	69,000[3]
TBT	mg/kg-OC	Not Available	76
TBT	µg/kg	Not Available	1,335[3]

Notes:
1 Compliance criteria based on SQS chemical criteria per Washington State Sediment Management Standards (SMS; Chapter 173-204 WAC).
2 Confirmational numbers based on 2003 ESD.
3 Compliance criteria based on the dry weight concentration will be used when the total organic carbon (TOC) value is less than 1%.
4 Low-molecular weight polycyclic aromatic hydrocarbons.
5 High-molecular weight polycyclic aromatic hydrocarbons.

Table 5.1
Visual Inspections for the Under-pier Capped Areas

Type of Monitoring	• Visual diver survey of under-pier sand capped areas. Total of 17 transects to be surveyed (refer to Figure 3.1).
Schedule/Frequency	• Baseline survey (Year 0) in fall 2007 • Monitoring surveys in Year 1 (2008), Year 2 (2009), and Year 4 (2011). • Subsequent monitoring survey in Year 9 (2016) if sand cap material remains stable over the first three monitoring surveys. • Supplemental monitoring survey within 60 days after an earthquake that causes liquefaction of soils or building damage, at or near the site (magnitude 6.0 or greater).
Documentation	• Log and audio/video recording of observations such as the substrate type and coverage of sand cap, unusual erosion or accretion of material, presence of debris or unusual materials that are not part of the sand cap. Detailed observations to be made every 10 feet along each transect. • For the baseline survey: data tables including sediment grab sample grain-size distribution results and a figure showing the sample locations. Two samples will be collected along each transect. • For the monitoring surveys: data tables including sediment grab sample grain-size distribution results and a figure showing the sample locations, if collected. Grab samples will only be collected if the diver is unable to visually determine the type of substrate. • Under-Pier Physical Integrity Monitoring Reports after each survey event. • Written notification to USEPA will be made within 30 days of observations of under-pier capped areas that have complete erosion of the sand cap.
Comparative Data	• Previous observations and video recordings. • Baseline grab sample grain-size distributions.
Threshold for Action	• These under-pier areas have been covered with either a 1-foot layer of sand (Piers 1A, 1, 2P, 3, 6, and 6P and within the over-water areas of the building berth) or a 3-feet layer of sand (Piers 4N and 5). • Movement of the cap material may decrease or increase the cap thickness at various locations. Such movement was expected in the design. Observation of complete erosion of the sand cap along a transect would trigger investigation into the size of the area affected, evaluation of the cause, and potential action in accordance with Section 9.0.

Table 5.2
Visual Inspections for the Northeast Shoreline Sediment Cap

Type of Monitoring	• Visual diver/surveyor survey of the Northeast Shoreline Sediment Cap for baseline and routine monitoring surveys. One transect to be surveyed (refer to Figure 3.1). • Visual shoreline survey of the riprap on the cap for supplemental monitoring surveys at low tide.
Schedule/Frequency	• Baseline survey (Year 0) in fall 2007. • Monitoring surveys in Year 1 (2008), Year 2 (2009), and Year 4 (2011). • Subsequent monitoring survey in Year 9 (2016) if riprap remains stable over the first three monitoring surveys. • Supplemental monitoring survey during a low tide within 60 days after a severe storm or an earthquake or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner, as described in Section 5.1.1.2. Note that the visual shoreline survey may be changed to a visual diver survey if a sufficiently low tide is not available during daylight hours.
Documentation	• Log and audio/video recording of observations such as the substrate type and coverage of the riprap, unusual erosion or accretion of material, presence of debris or unusual materials that are not part of the riprap Detailed observations to be made every 10 feet along each transect. • Physical Integrity Monitoring Reports after each survey event. • Written notification to USEPA will be made within 30 days of observations of areas of the Northeast Shoreline Sediment Cap that have complete erosion of the riprap.
Comparative Data	• Previous observations and video recordings.
Threshold for Action	• For the Northeast Shoreline Sediment Cap, a 3-foot riprap layer was placed over a minimum 2–foot-thick isolation layer of gravelly sand. • Observation of erosion of the riprap along the transect would trigger investigation into the size of the area affected, evaluation of the cause, and potential action in accordance with Section 9.0.

Table 5.3
Visual Inspections for the Western Shoreline Habitat Bench

Type of Monitoring	• Visual diver survey of the Western Shoreline Habitat Bench for baseline and routine monitoring surveys. Total of 3 transects to be surveyed (refer to Figure 3.1). • Visual shoreline survey of the habitat bench for supplemental monitoring surveys at low tide.
Schedule/Frequency	• Baseline survey (Year 0) in fall 2007. • Monitoring surveys in Year 1 (2008), Year 2 (2009), and Year 4 (2011). • Subsequent monitoring survey in Year 9 (2016) if Type 2 Habitat mix remains stable over the first three monitoring surveys. • Supplemental monitoring survey during a low tide within 60 days after a severe storm or an earthquake or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner, as described in Section 5.1.1.3. Note that the visual shoreline survey may be changed to a visual diver survey if a sufficiently low tide is not available during daylight hours.
Documentation	• Log and audio/video recording of observations such as the substrate type and coverage of habitat mix, unusual erosion or accretion of material, presence of debris or unusual materials that are not part of the habitat mix. Detailed observations to be made every 10 feet along each transect. • Physical Integrity Monitoring Reports after each survey event. • Written notification to USEPA will be made within 30 days of observations of areas on the habitat bench that have complete erosion of the habitat mix.
Comparative Data	• Previous observations and video recordings. • Grain-size distribution of the Type 2 Habitat Mix (refer to Figure 1.2).
Threshold for Action	• At the habitat bench, a 3-foot-deep layer of Type 2 Habitat Mix was placed over a minimum 2-foot-thick sand cover. • Movement of the habitat mix may decrease or increase the thickness of the habitat mix at various locations. Observation of complete erosion of the habitat mix along a transect would trigger investigation into the size of the area affected, evaluation of the cause, and potential action in accordance with Section 9.0.

Table 8.1
Physical Integrity Monitoring Schedule

	Year 0 (2007)	Year 1 (2008)	Year 2 (2009)	Year 3 (2010)	Year 4 (2011)	Year 5 (2012)	Year 6 (2013)	Year 7 (2014)	Year 8 (2015)	Year 9 (2016)
Baseline Monitoring	✓									
Long-term Monitoring		✓	✓		✓					✓

Notes:
Baseline and long-term monitoring will occur at the under-pier capped areas, the Northeast Shoreline Sediment Cap, and the Western Shoreline Habitat Bench.
Supplemental monitoring events may also occur due to earthquakes or severe storms.
Long-term monitoring in 2011 and 2016 corresponds with USEPA's Five-Year Reviews.

Table 9.1
Potential Contingency Actions

Early Action Warning Level Exceendances	• Investigate causes of any significant erosion areas (i.e., areas of complete erosion of under-pier sand cap material, erosion of riprap on the Northeast Shoreline capped area, or complete erosion of the habitat mix on the habitat bench). • Implement best management practices (BMPs) or operational controls if erosion is caused by propwash action or other shipyard operations. • Continue to monitor eroded area to ensure the extent of erosion does not increase over time.
Performance Standard Exceedances	• Investigate causes of any significant erosion areas (i.e., areas of complete erosion of under-pier sand cap material, erosion of riprap on the Northeast Shoreline capped area, or complete erosion of the habitat mix on the habitat bench). • Implement BMPs or operational controls if erosion is caused by propwash action or other shipyard operations. • In under-pier areas where the sand cap has fully eroded over an area larger than 5,000 square feet, conduct sampling of underlying sediment to determine if underlying sediment has constituents of concern above action levels and if material replacement should be considered. • Evaluate the feasibility of installing replacement material. • Prepare Contingency Action Planning Report.

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Figures

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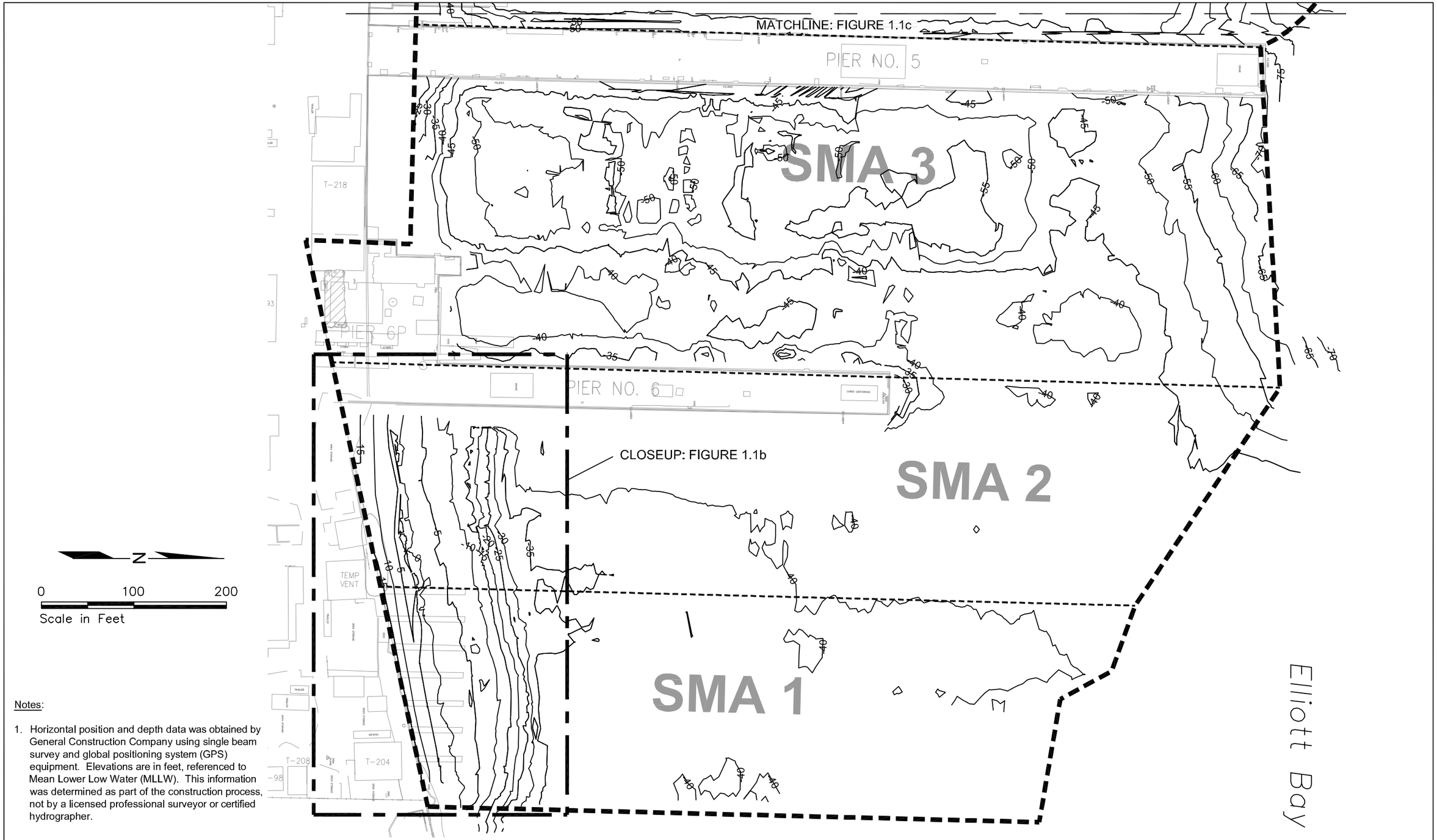

Notes:

1. Horizontal position and depth data was obtained by General Construction Company using single beam survey and global positioning system (GPS) equipment. Elevations are in feet, referenced to Mean Lower Low Water (MLLW). This information was determined as part of the construction process, not by a licensed professional surveyor or certified hydrographer.

Base Map Source: Walker Associates, 2002 and 2003.

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Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure 1.1a
Post-remediation Site Bathymetry

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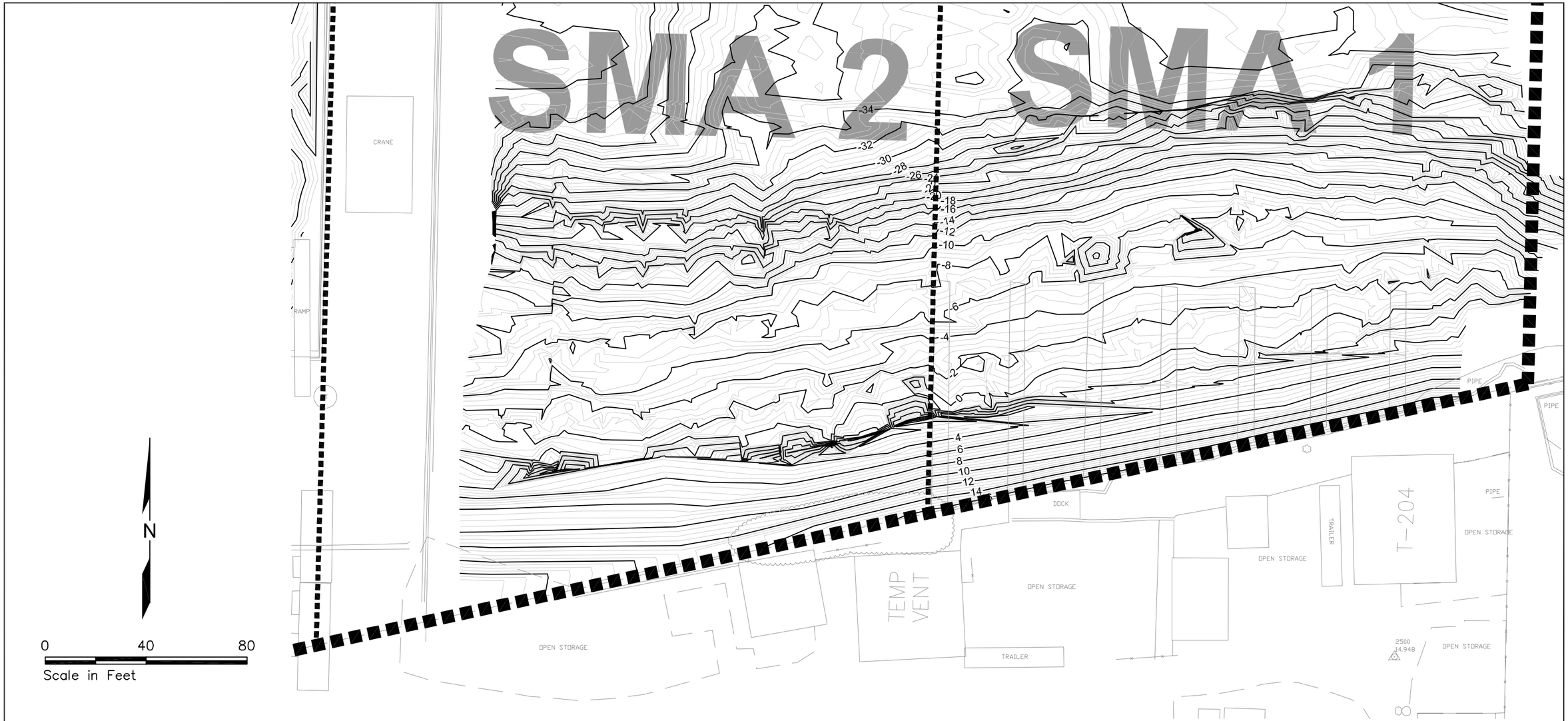

Notes:

1. Horizontal position and depth data was obtained by General Construction Company using single beam survey and global positioning system (GPS) equipment. Elevations are in feet, referenced to Mean Lower Low Water (MLLW). This information was determined as part of the construction process, not by a licensed professional surveyor or certified hydrographer.

Base Map Source: Walker Associates, 2002 and 2003.

FLOYD | SNIDER strategy ▪ science ▪ engineering	**Operation, Maintenance, and Monitoring Plan Todd Shipyards Sediment Operable Unit**	Figure 1.1b Post-remediation Site Bathymetry

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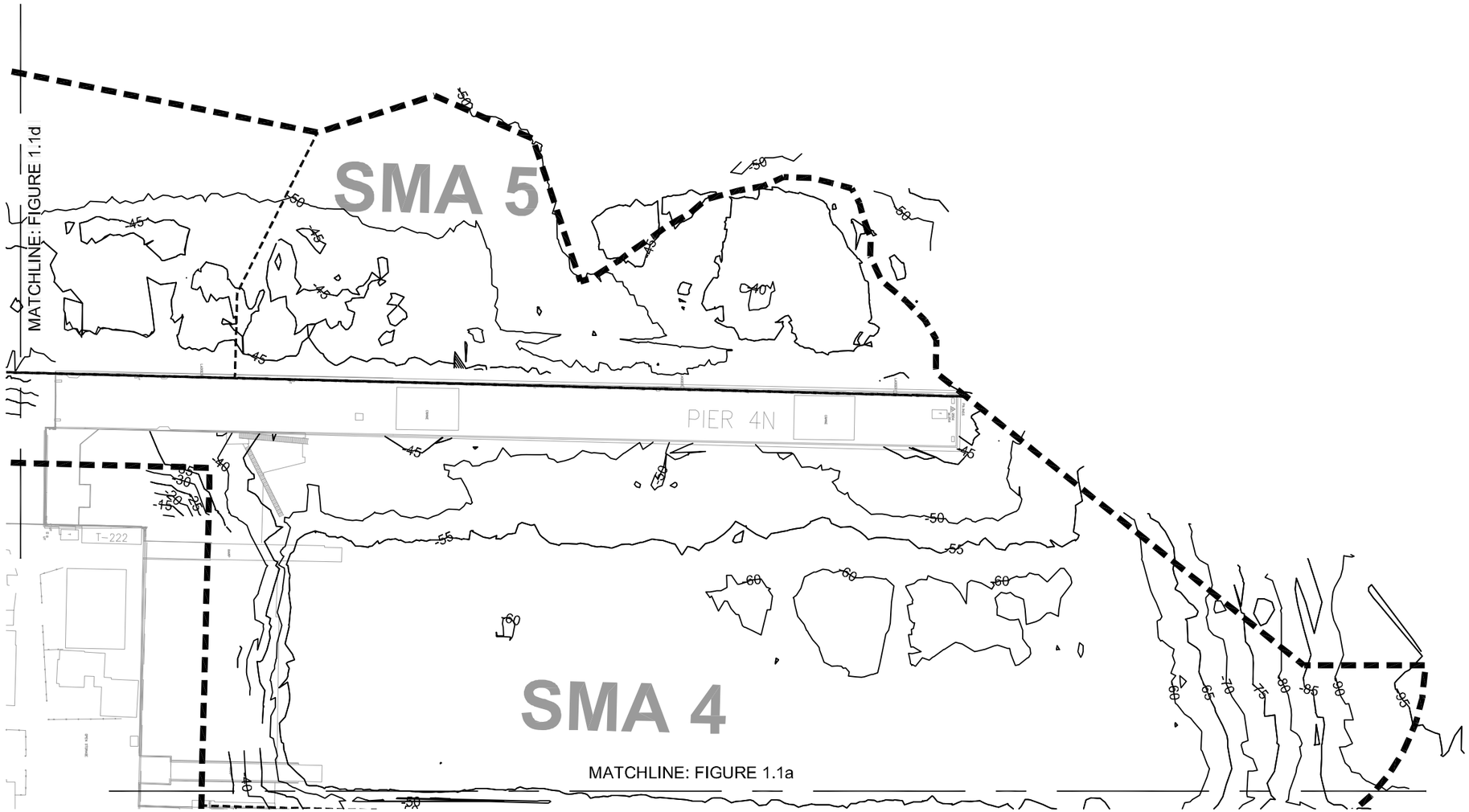

Notes:

1. Horizontal position and depth data was obtained by General Construction Company using single beam survey and global positioning system (GPS) equipment. Elevations are in feet, referenced to Mean Lower Low Water (MLLW). This information was determined as part of the construction process, not by a licensed professional surveyor or certified hydrographer.

N

0 100 200
Scale in Feet

Base Map Source: Walker Associates, 2002 and 2003.

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Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure 1.1c
Post-remediation Site Bathymetry

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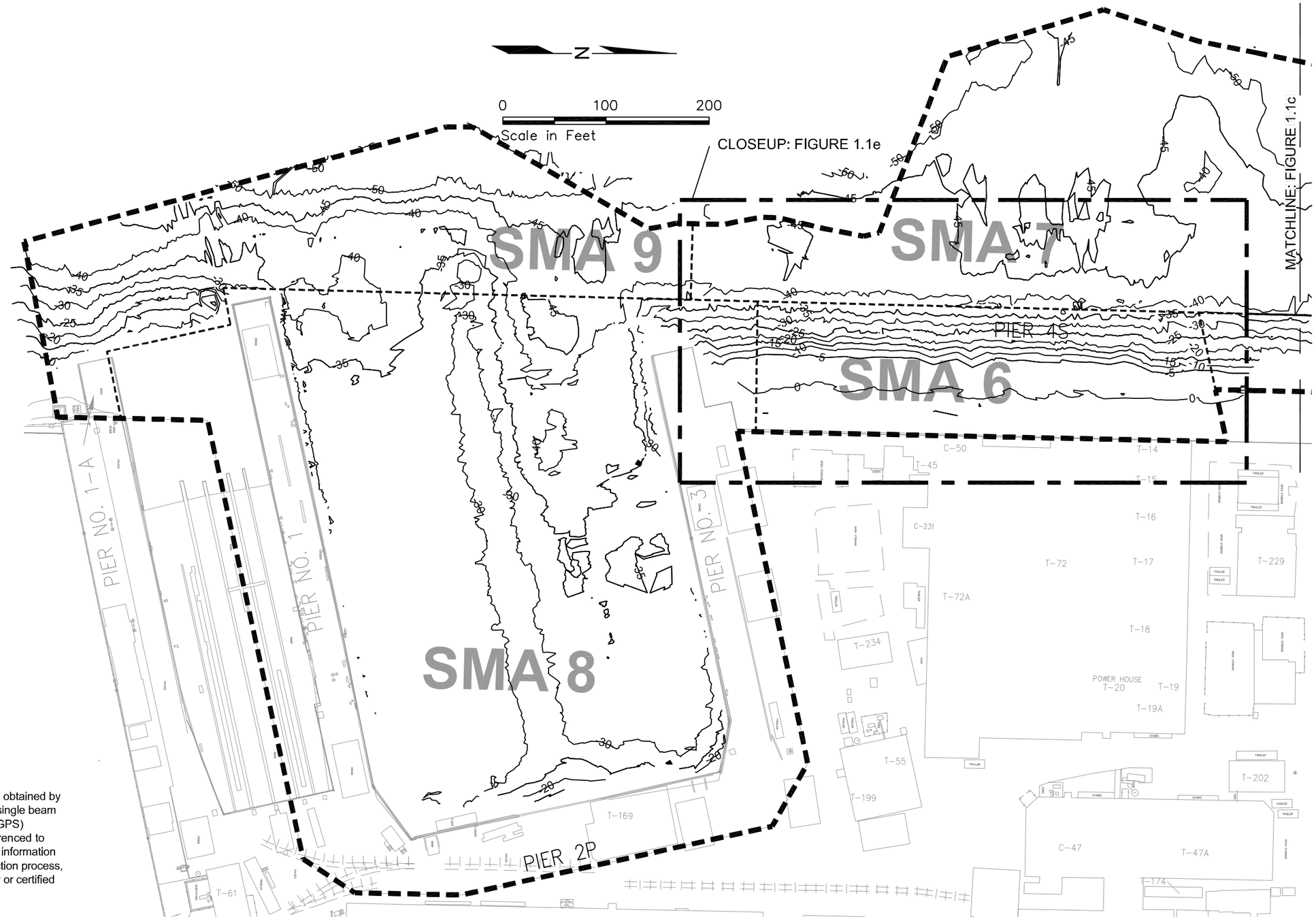

Notes:

1. Horizontal position and depth data was obtained by General Construction Company using single beam survey and global positioning system (GPS) equipment. Elevations are in feet, referenced to Mean Lower Low Water (MLLW). This information was determined as part of the construction process, not by a licensed professional surveyor or certified hydrographer.

Base Map Source: Walker Associates, 2002 and 2003.

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Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure 1.1d
Post-remediation Site Bathymetry

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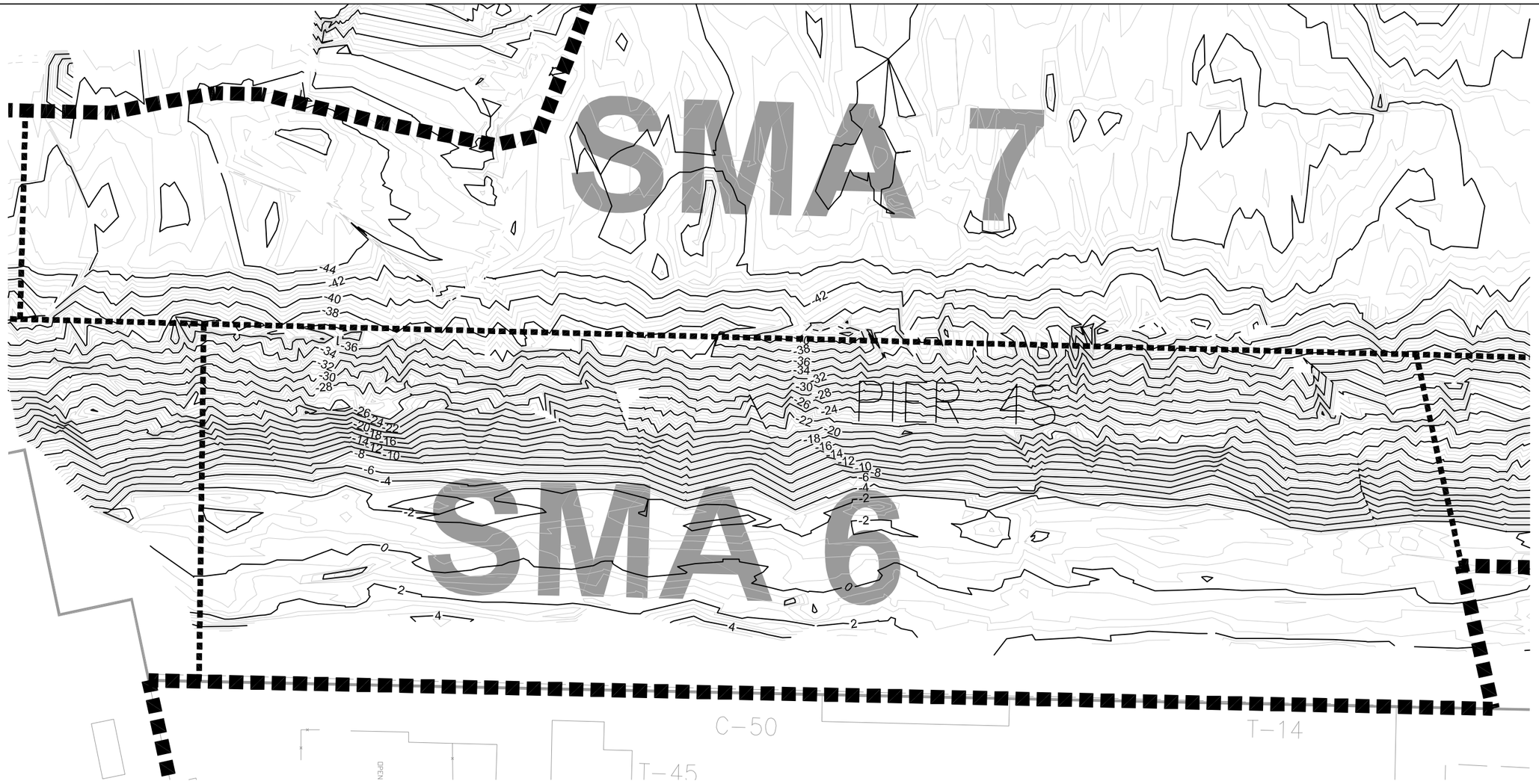

Notes:

1. Horizontal position and depth data was obtained by General Construction Company using single beam survey and global positioning system (GPS) equipment. Elevations are in feet, referenced to Mean Lower Low Water (MLLW). This information was determined as part of the construction process, not by a licensed professional surveyor or certified hydrographer.

Base Map Source: Walker Associates, 2002 and 2003.

N

0 40 80

Scale in Feet

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Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure 1.1e
Post-remediation Site Bathymetry

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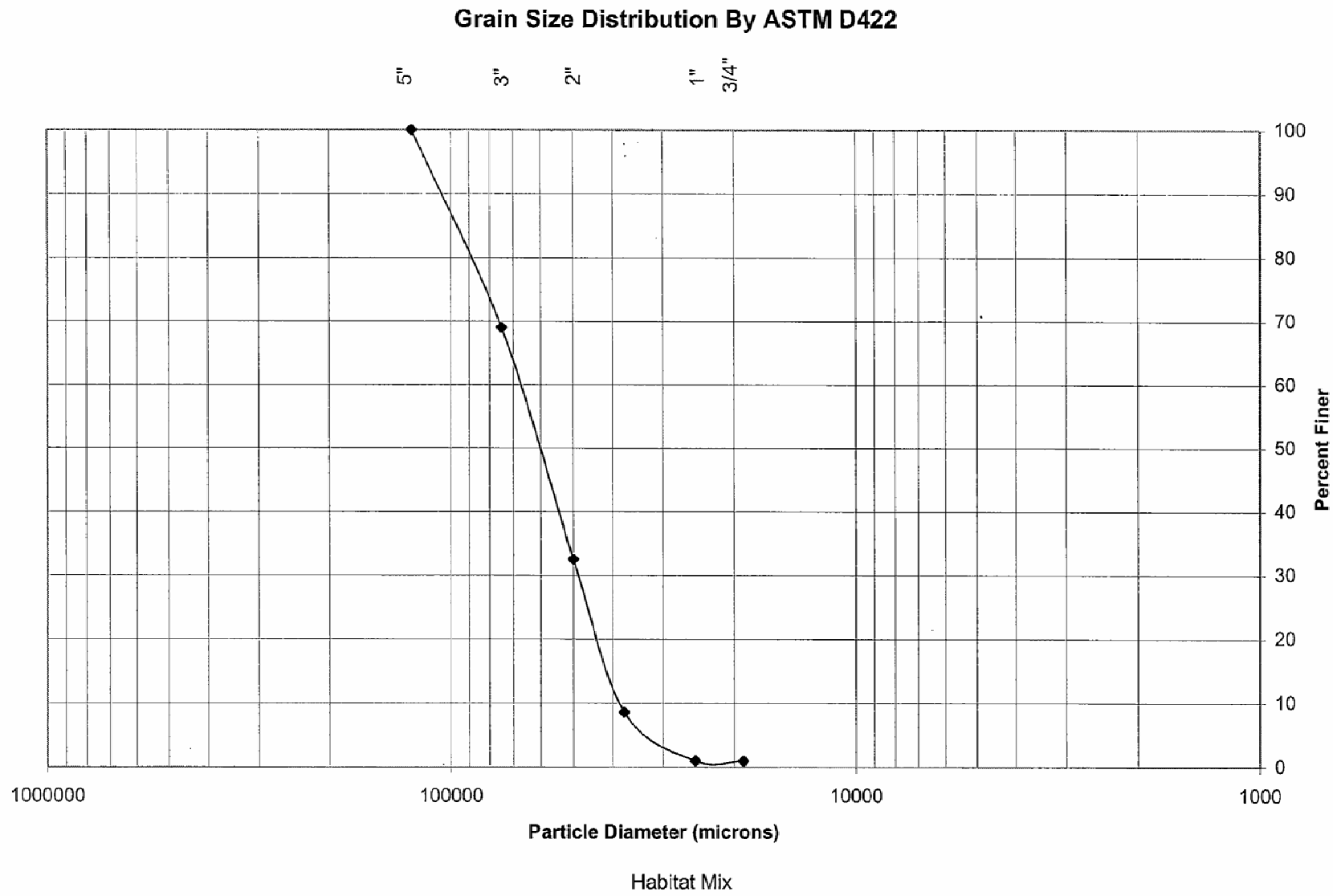
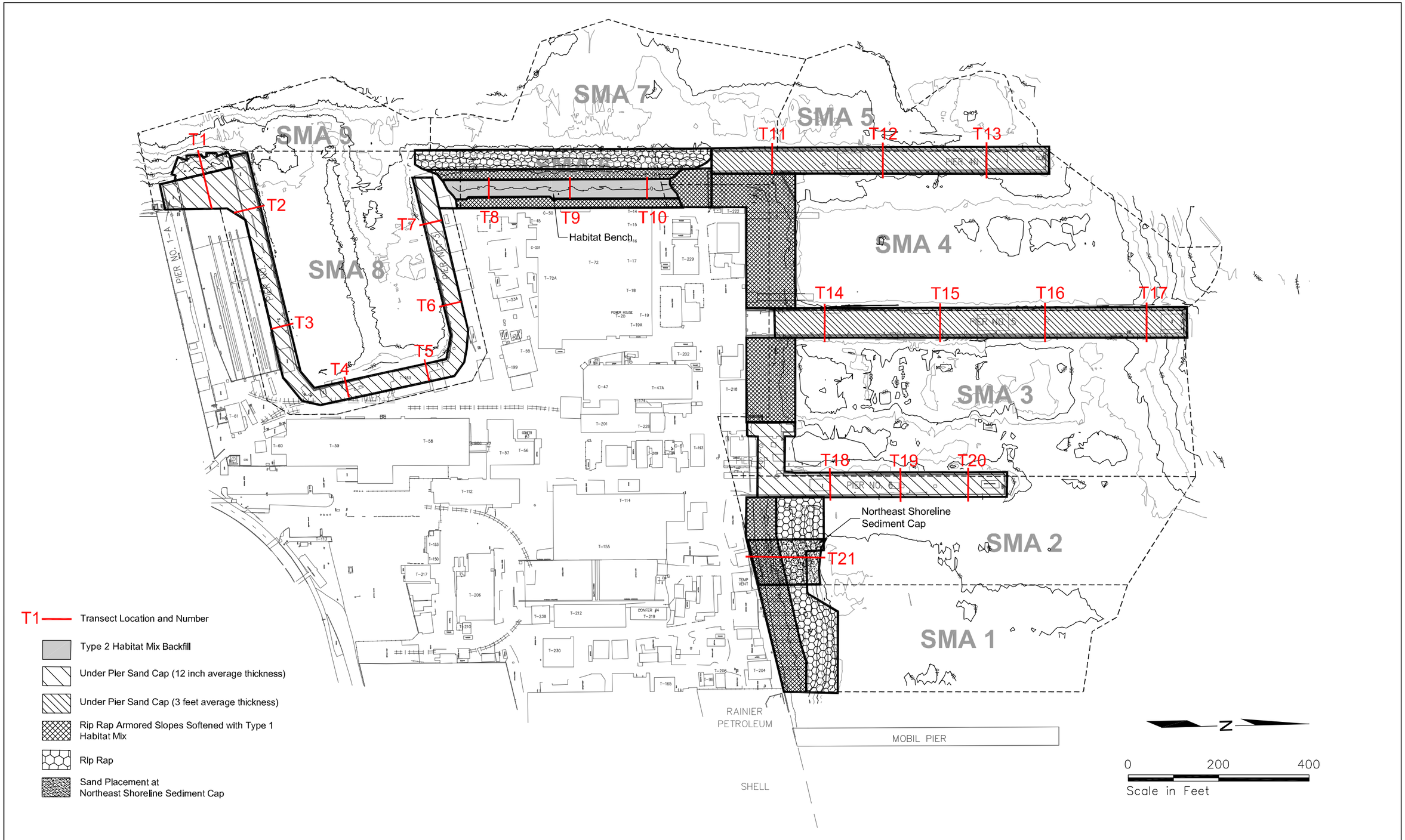


Source: Analytical Resources Incorporated

FLOYD | SNIDER strategy ▪ science ▪ engineering	**Operation, Maintenance, and Monitoring Plan** **Todd Shipyards** **Sediment Operable Unit**	Figure 1.2 Type 2 Habitat Mix Grain-size Distribution

F:\projects\TODD-NPL\Sediment OU\4000 Series\Final OMMP\Updated OMMP 2007\Figures\Figure 1.2.doc
8/6/2007



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Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure 3.1
Transect Locations for Physical Integrity Monitoring Surveys

DWG NAME: G:\project\Clients\Floyd and Snider\todd\technical\todd0154 (OMMP Transect).dwg
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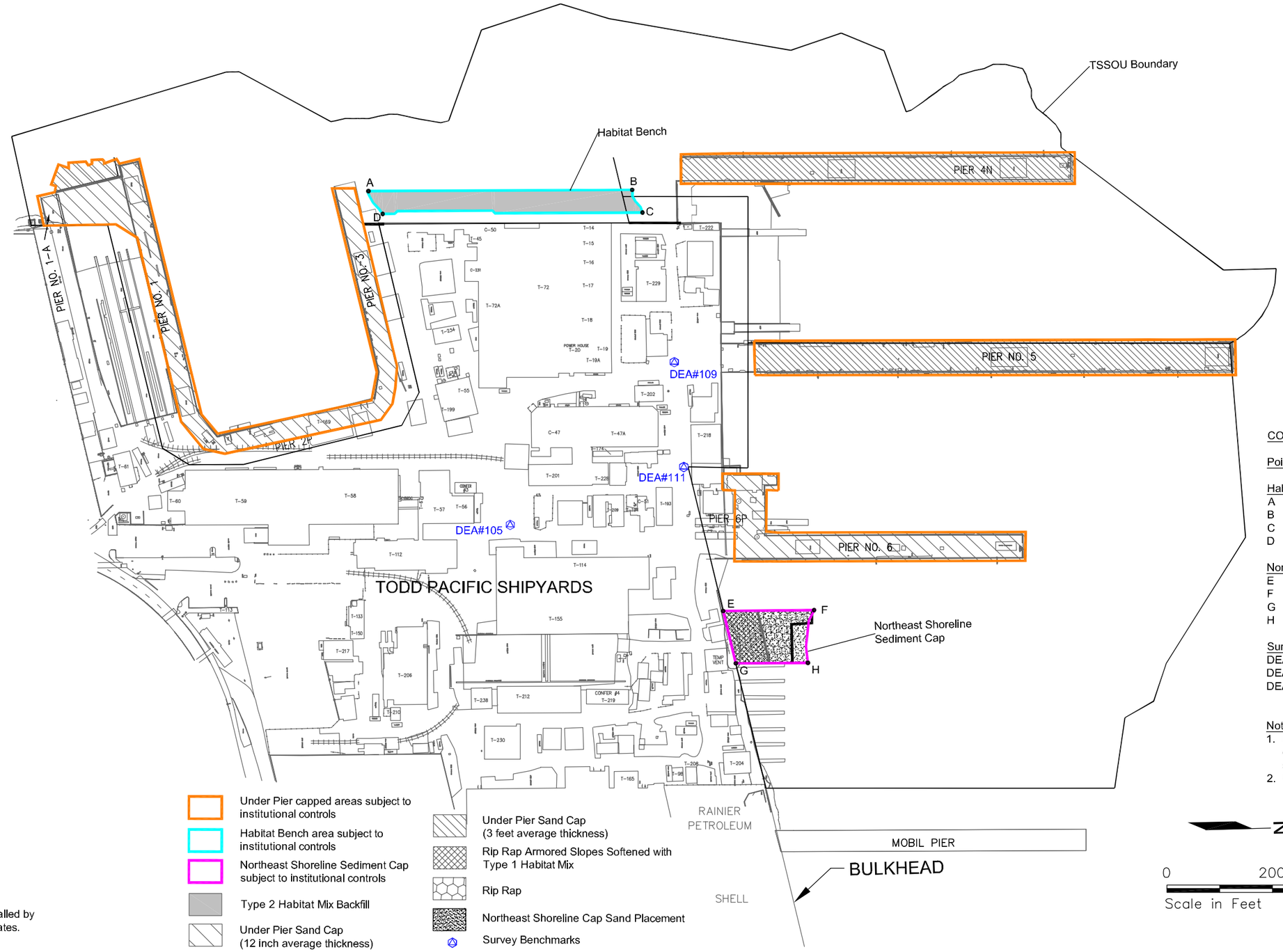

Survey Benchmarks installed by David Evans and Associates. See Figure 6.2.

COORDINATES

Point No.	Northing	Easting
Habitat Bench		
A	217125.5	1264140.6
B	217625.4	1264150.9
C	217643.8	1264194.2
D	217151.3	1264184.5
Northeast Shoreline Sediment Cap		
E	217777.5	1264953.5
F	217949.9	1264956.1
G	217798.9	1265053.2
H	217935.8	1265055.6
Survey Benchmarks		
DEA#105	217378.15	1264779.96
DEA#109	217696.71	1264479.48
DEA#111	217709.85	1264678.52

Notes:
1. Limits of under-pier capped areas are defined by extent of existing pier structures.
2. Horizontal Datum: NAD 83.

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KATHRYN H. SNIDER
STATE OF WASHINGTON
29338
REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 3/26/2009

Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure 6.1
Institutional Controls Plan

DWG NAME: G:\project\clients\Floyd and Snider\todd\technical\todd0165.dwg
DATE: 07/31/07 3:54pm

SURVEY NOTES

1. **PURPOSE OF THIS DRAWING**: TO GRAPHICALLY DEPICT THE LOCATIONS OF DAVID EVANS AND ASSOCIATES, INC. SURVEY CONTROL THAT HAS BEEN ESTABLISHED AT TODD SHIPYARD. NOTE: THE CURRENT CONDITION OF SHOWN CONTROL HAS NOT BEEN VERIFIED.

2. **DATES OF SURVEY** FROM SEPTEMBER 2002, TO JANUARY 2006.

3. **HORIZONTAL DATUM** NORTH AMERICAN DATUM 1983-91 ADJUSTMENT (NAD83/91), STATE PLANE COORDINATE SYSTEM (SPCS), WASHINGTON NORTH ZONE.

4. **VERTICAL DATUM** MEAN LOWER LOW WATER (MLLW).

5. **SITE MAP** BACKGROUND MAP AND FEATURES WERE PROVIDED BY OTHERS AND ARE SHOWN FOR REFERENCE ONLY.

TIDAL DATUMS FOR NOAA STATION 9447130
PUGET SOUND, SEATTLE, WA
LENGTH OF SERIES: 19 YEARS
TIME PERIOD: 1960-1978
TIDAL EPOCH: 1960-1978

DATUM PLANE	EL. IN FEET (MLLW)
MEAN HIGHER HIGH WATER (MHHW)	=11.35
MEAN HIGH WATER (MHW)	=10.49
MEAN SEA LEVEL (MSL)	=6.63
MEAN LOW WATER (MLW)	=2.83
NORTH AMERICAN VERTICAL DATUM - 1988 (NAVD)	=2.51
MEAN LOWER LOW WATER (MLLW)	=0.00

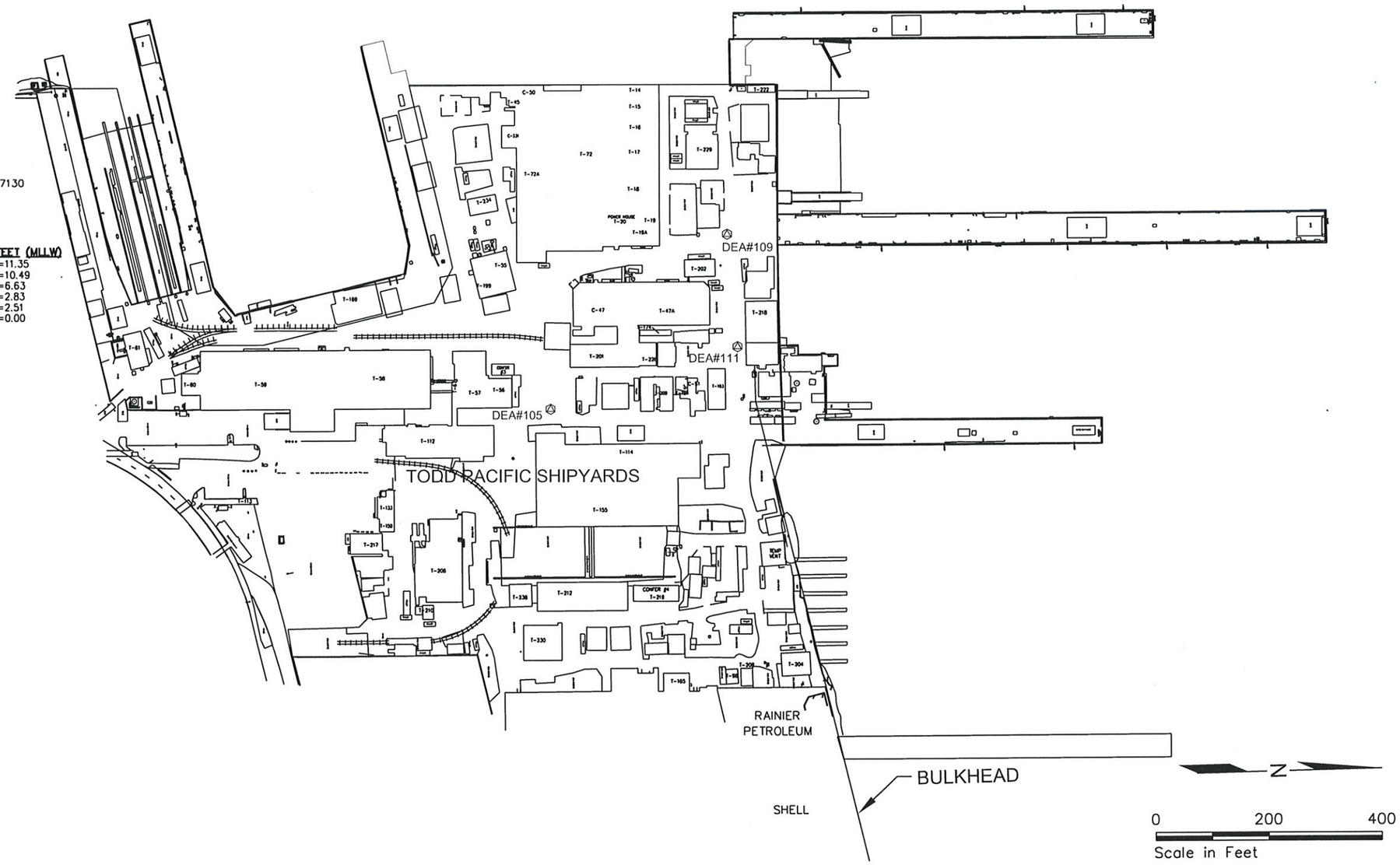
Survey Benchmarks

SURVEY BENCHMARK COORDINATES

Point No.	Northing	Easting
DEA#105	217378.15	1264779.96
DEA#109	217696.71	1264479.48
DEA#111	217709.85	1264678.52

8-01-07

ROBERT C. MITCHELL
STATE OF WASHINGTON
36806
REGISTERED
PROFESSIONAL LAND SURVEYOR
EXPIRES 02/08/09



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Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure 6.2
Survey Benchmarks

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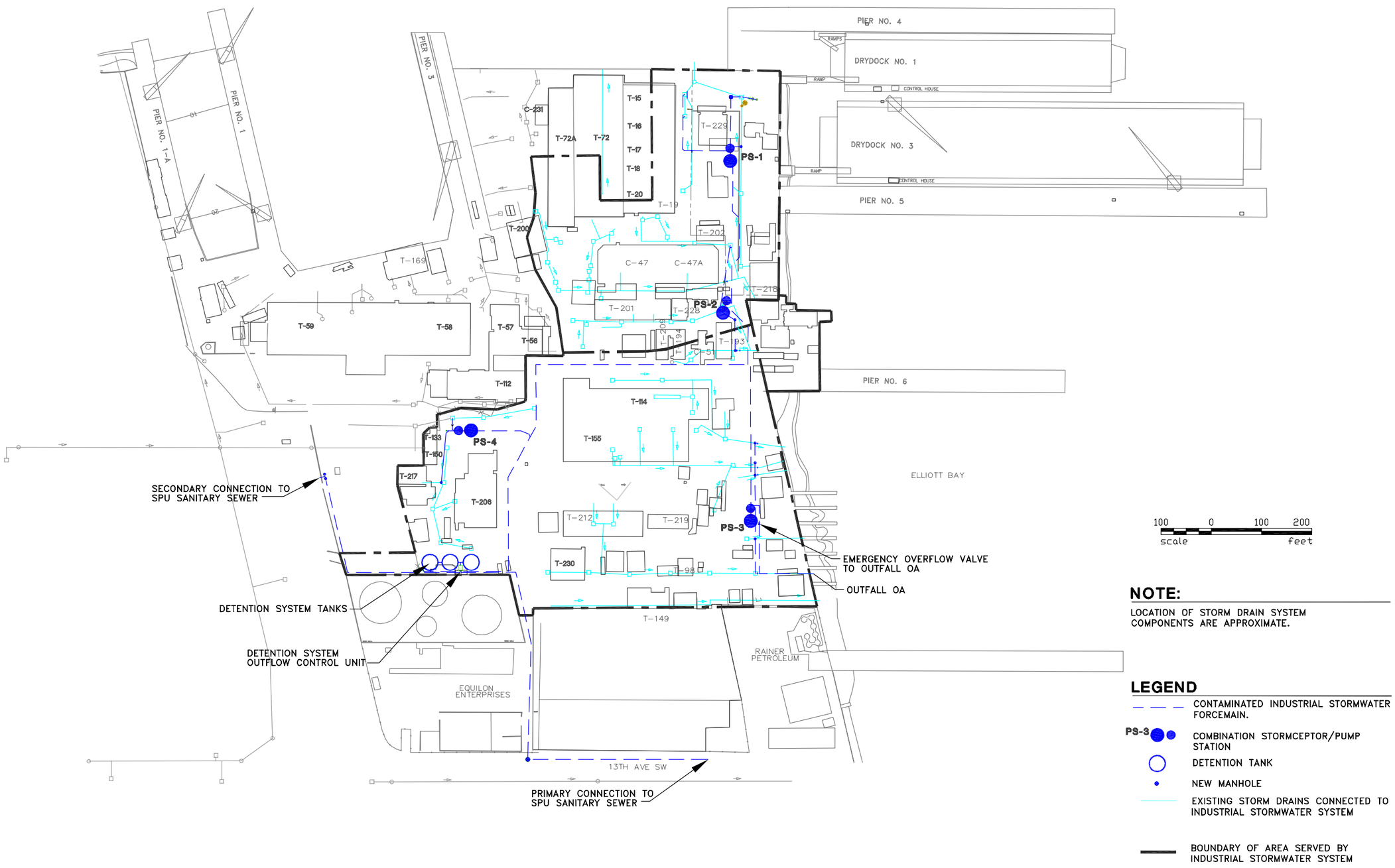
DATE: 07/31/07 4:03pm



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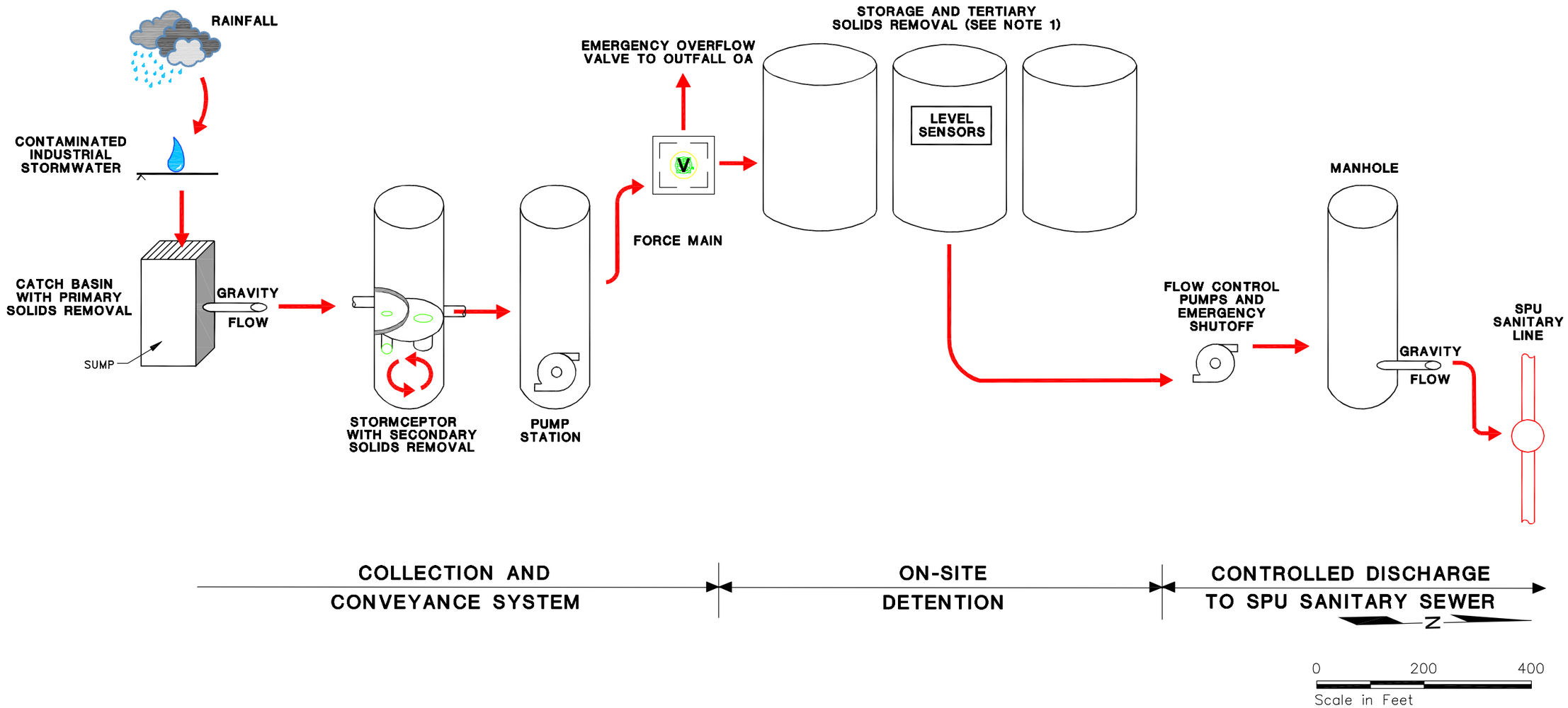
Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure 7.1
Industrial Stormwater Collection and Treatment System

DWG NAME: G:\project\Clients\Floyd and Snider\todd\technical\todd0155 (OMMP Plan).dwg
DATE: 07/20/07 10:56am

NOTE:

1. STORAGE DESIGNED TO PREVENT THE FIRST FLUSH OF STORMWATER (WITH THE MAJORITY OF YARD CONTAMINANTS) FROM ENTERING SURFACE WATERS VIA EMERGENCY OVERFLOW VALVE TO OUTFALL OA.



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Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure 7.2
Process Flow Diagram -
Industrial Stormwater Collection & Treatment System

DWG NAME: G:\project\Clients\Floyd and Snider\todd\technical\todd0156 (OMMP Process Flow).dwg
DATE: 07/20/07 10:59am

Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Appendix A
TSSOU Regulatory and Remedy History

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Appendix A
TSSOU Regulatory and Remedy History

SITE BACKGROUND

Todd Pacific Shipyards (Todd) is a 30-acre facility located within the Harbor Island Superfund Site. Harbor Island is an industrial area situated at the mouth of the Duwamish Waterway in Seattle, Washington. The industrial island comprises approximately 400 acres plus the adjacent marine sediments in Elliott Bay. The Todd facility is located on the northwest corner of Harbor Island.

The Todd facility, in operation since 1916, is the largest and most productive private ship repair and construction facility in the Pacific Northwest. The Todd marine facilities includes three dry docks and associated piers located on the north end of Harbor Island, two shipways located on the southwest portion of the facility accessed via the West Waterway of the Duwamish River, and nine additional berths located adjacent to Piers 1 through 6 (Figure A.1). Washington State (managed through the Department of Natural Resources [DNR]) owns all of the TSSOU waterward of the Inner Harbor Line.

Todd provides full service shipyard capabilities to various marine-based industries. Todd's work includes new construction, repair, maintenance, and refurbishing of ships operated by the U.S. military, fishing fleets, cargo shippers, Washington State ferries, and cruise lines. Todd's dry dock capacity is critical for repair of ships over 200 feet in length; alternative non-military dry docks of similar capacity can only be found in Portland and Canada. Operational facilities include shops for sandblasting, painting, pipe treatment and fabrication, rigging, carpentry, welding, machining, plate bending, and electrical and copper work.

Todd holds key multi-year contracts for ship repair and maintenance with the U.S. Navy. Contracts for U.S. Navy vessel repair and maintenance are critical to national security during this time of war. Todd provides living-wage employment for 800 to 1200 employees annually, primarily union labor.

TSSOU REGULATORY BACKGROUND

The following section provides a summary of the regulatory history with USEPA and the requirements for cleanup of the TSSOU.

Regulatory History

The Site Record of Decision (ROD; USEPA 1996) governing the Shipyard Sediment Operable Unit for Harbor Island was issued in November 1996. An Administrative Order on Consent (AOC) and associated Statement of Work (SOW) for Remedial Design Sampling was signed in June 1997. Phase 1A characterization activities were completed as defined in the 1997 SOW. The USEPA conducted additional characterization (Phase 1B) in January 1999. Based on the characterization results, USEPA prepared an Explanation of Significant Differences (ESD) in December 1999 (USEPA 1999). The 1999 ESD designated the TSSOU as a distinct cleanup unit and expanded the TSSOU boundaries. In April 2000, an AOC and associated SOW was

finalized for remedial design (USEPA 2000). USEPA issued another ESD in March 2003 (USEPA 2003a) that:

- Further defined the selected remedy for the under-pier areas
- Established confirmational numbers characteristic of contamination present in the West Waterway for the purpose of adjusting the TSSOU boundary
- Adjusted the TSSOU boundary
- Summarized the long-term operational, maintenance, and monitoring parameters for the TSSOU
- Defined "predominantly abrasive grit blast"
- Identified the disposal approach for contaminated sediments

A Consent Decree (CD; USEPA 2003b) and associated SOW for the remedial action and long-term monitoring for the TSSOU (USEPA 2003c) was finalized in May 2003.

To facilitate the remedial design decision-making process, the TSSOU was subdivided into nine SMAs based on land-based features, physical obstructions, extent of open water, and the TSSOU boundary. These nine SMAs are more clearly shown on Figure A.1.

Record of Decision and Remedial Action Statement of Work Requirements

The remedial action cleanup objective for the TSSOU, as stated in the ROD, is to reduce concentrations of hazardous substances to levels that will have no adverse effect on marine organisms (USEPA 1996). For a complete description of the remedy for the TSSOU, refer to the ROD and applicable ESDs (USEPA 1996, 1999, 2003a). To meet the stated ROD cleanup objective and the requirements of the Remedial Action SOW, Todd agreed to conduct the following remedial activities (USEPA 2003c):

- All contaminated sediments and shipyard waste in the open-water areas of the TSSOU will be dredged to depths where contaminant concentrations are less than chemical and/or biological sediment quality standards (SQS) as defined by the Washington State Sediment Management Standards (SMS; Chapter 173-204 WAC).
- Dredged sediments will be disposed of at an appropriate upland disposal facility.
- Sediment samples will be collected from the post-dredge surface and compared to SQS to verify that performance standards have been achieved. Sediment samples will also be collected from berth deepening areas for characterization of sediment for Puget Sound Dredge Disposal Analysis (PSDDA) disposal.
- Piers 2 and 4S will be demolished and underlying sediments will be dredged to depths where contaminant concentrations are less than SQS, following which Pier 4S will be reconstructed.
- Side-launch shipways on the northeast shoreline will be demolished to facilitate dredging of contaminated sediments. A new ship launching facility will be constructed in this area following dredging to replace the side-launch shipways.

- A sand cap will be placed under Piers 1, 1A, 2 Platform (2P), 3, 6, 6P, and the Building Berth to an average thickness of 1 foot in areas requiring remediation. The sand cap will extend beyond the pier footprints to include the "no dredge zone" immediately adjacent to the piers. Contaminated sediments underneath Piers 1, 1A, 2P, 3, 6, 6P, and the Building Berth will be fully remediated, after demolition, when the existing structures reach the end of their serviceable life.
- A sand cap will be placed under Piers 4N and 5 to an average thickness of 3 feet in areas requiring remediation. The sand cap will extend beyond the pier footprints to include the "no dredge zone" immediately adjacent to the piers. Contaminated sediments underneath Piers 4N and 5 will be fully remediated, after demolition, when the existing structures reach the end of their serviceable life.
- Sources of contaminants to the sediments will be controlled before remedial action implementation is complete. Source control actions include upgraded management of sandblast grit, as well as collection and treatment of contaminated industrial stormwater to prevent sediment recontamination.
- The existing timber Dry Dock 2 will be replaced with a metal surfaced dry dock as an element of site source control, allowing better future collection of spent sandblast grit. The metal surfaced dry dock will be relocated to the east side of Pier 6. Dredging to increase berth depths will be conducted along the east side of Pier 6 to accommodate the new dry dock, and a new anchoring system and access ramp will be constructed.
- During in-water activities, water quality monitoring will be performed and compared to Washington State acute marine water quality criteria or background concentrations and, if necessary, corrective actions will be taken to mitigate impacts to water quality during construction.
- Dredging, capping, and disposal methods will be utilized to minimize adverse impacts to habitat and minimize the release and resuspension of contaminated sediments to the environment.
- Remedial activities will be conducted following BMPs to avoid and minimize adverse impacts to the aquatic environment, which includes avoiding fish-critical activity periods for in-water work and implementation of conservation measures that protect species listed on the Endangered Species Act (ESA).
- Long-term maintenance and monitoring of the under-pier sand cap will be conducted at the TSSOU to verify the continued effectiveness of the remedy. As part of 5-year reviews, USEPA may also require monitoring of the open-water areas.

The remedy for the TSSOU meets the ROD cleanup objective and Applicable or Relevant and Appropriate Requirements (ARARs), while supporting continued operations at the shipyard.

Cleanup Standards

The chemicals of concern (COCs) identified in the TSSOU sediments include arsenic, copper, lead, mercury, zinc, tributyltin (TBT), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs).

Cleanup compliance criteria used for the TSSOU remedial action are the chemical and/or biological SQS as defined by the Washington State Sediment Management Standards (SMS; Chapter 173-204 WAC). The one exception is for tributyltin (TBT), where no SQS criterion exists and the compliance criterion is based on the confirmational number stated in the 2003 ESD. The TSSOU compliance criteria are presented in Table 1.1 of the main text.

TSSOU REMEDIAL ACTIVITIES

Prior to remedial action construction, Todd implemented two primary source control projects to eliminate shipyard sources of sediment contamination in 2003. Stormwater management infrastructure was reconstructed throughout the primary industrial areas of the yard and operational changes were made regarding the handling of AGB. Additional construction activities at Todd that took place in 2003 related to the remedial action included utility relocation and north trestle construction.

Remedial action construction work was initiated in July 2004. Remedial construction efforts during the first season were focused along the north end of the Site, and included:

- Completed demolition and disposal of the side-launch shipways, located along the Northeast Shoreline in SMA 1, and Pier 2, located in SMA 8.
- Completed dredging and disposal of contaminated sediment and shipyard debris in SMAs 1, 2, 3, 4, and 5, located on the north side of the Todd property.
- Completed placement of under-pier cap material at Pier 4N, Pier 5, Pier 6, and Pier 6P.
- Completed placement of in-water fill, including reconstruction of the Northeast Shoreline slope in SMAs 1 and 2; filling of subtidal depressions in SMAs 3, 5, and 7; and placement of boundary sand in SMAs1 and 5.
- Initiated, but did not complete, dredging and disposal of contaminated sediment in SMAs 7, 8, and 9.

Following completion of dredging in SMAs 1 and 2, sampling and analysis determined that project cleanup criteria had not been met at two of the sampling locations in SMA 2. Additional dredging to remove the remaining contaminated sediment was not possible because of slope stability constraints. The design of the fill slope in SMA 2 was modified following a determination that post-dredge sediments along the slope did not meet project chemical cleanup criteria. The design revision provided a thicker section of gravelly sand between the post-dredge surface and the overlying riprap armoring, allowing the fill to act as a permanent cap. The cap matched the requirements of the isolation layer designed for the adjacent Lockheed Shipyard Sediment Operable Unit (LSSOU), as the LSSOU cap design was approved for containment of similar COCs.

Second season (2005-2006) remedial construction efforts were focused on the west end of the Site and included:

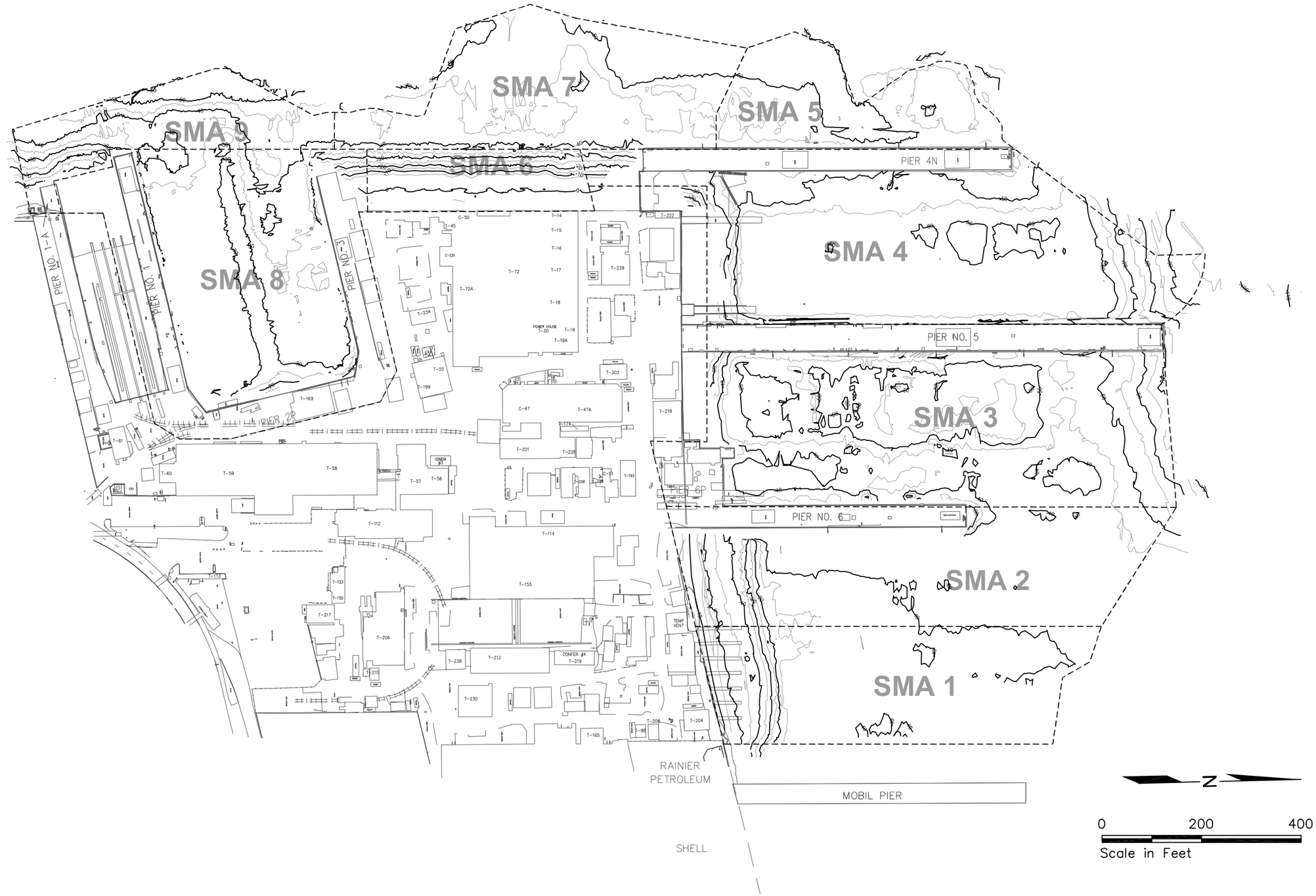
- Completed demolition and disposal of Pier 4S located in SMA 6 and removal of the decking from the western portion of the building berth located in SMA 8.

- Completed dredging and disposal of contaminated sediment and shipyard debris in SMAs 6, 7, 8, and 9, located on the west side of the Todd property.
- Completed placement of under-pier cap material at Piers 1A, 1, 2P, 3, and the building berth area.
- Completed placement of in-water fill including placement of boundary sand in SMA 7 and 9 and placement of fill in the subtidal depression in SMA 7.
- Completed construction of the SMA 6 buttress fill, habitat bench, and slope armoring.

Following completion of planned dredging within the bench area of SMA 6 sampling and analysis determined that project cleanup criteria had not been met. Based on this information the dredge design was modified, requiring additional dredging to accommodate placement of at least 5 feet of fill within the bench area. Re-dredging was completed and confirmatory samples were collected and analyzed. Chemical results were significantly improved; however, one of the three samples still contained chemical exceedances for several chemicals. It was determined that in lieu of conducting additional dredging the area would be covered by at least 2 feet of sand prior to the placement of 3 feet of habitat mix.

A summary of the capping and filling plan for the remedial action is included on Figure 3.1. Final project bathymetry is included in OMMP Figure 1.1. Results of the post-dredge conformational sampling are included in Appendix B along with a figure showing the sampling locations within the SMAs.

The final remedial construction effort occurred during the 2006-2007 in-water construction season and included the replacement of structures that had been demolished to facilitate sediment cleanup. This work included the installation of fender piling at Piers 5 and 6 and the construction of a replacement level-launch facility at Pier 4S. This replacement level-launch was originally going to be constructed in SMA 1, along the northeast shoreline, to replace the older level-launch that was demolished during construction in this area. Todd made the decision in 2005 not to reconstruct Pier 4S and decided to 2006 to relocate the planned ship-launch facility from the northeast shoreline to the western shoreline, within the former footprint of Pier 4S.



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Operation, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure A.1
Todd Pacific Shipyards Facility Base Map

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Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Appendix B
Final Progress Sampling Results

FINAL

Final Progress Sampling Results

Analytes	Units	Compliance Criteria[2]	Sampling Locations[1]						
			SMA 1						
			TSP-01-01	TSP-01-02	TSP-01-03	TSP-01-04	TSP-01-05	TSP-01-06	TSP-01-07
			9/21/2004	9/27/2004	9/27/2004	10/4/2004	10/4/2004	10/13/2004	10/13/2004
Metals									
Arsenic	(mg/kg)	57	13	3	4	3	4	3	6
Copper	(mg/kg)	390	105	18	27	22	36	23	58
Lead	(mg/kg)	450	109	5	12	4	10	6	24
Mercury	(mg/kg)	0.41	**0.68**	0.06	0.40	<0.06 U	0.09	0.14	0.30
Zinc	(mg/kg)	410	132	26	38	30	40	33	62
TOC	(%)	-	1.07	0.634	0.843	0.957	1.63	0.845	1.38
PCBs	(mg/kg - OC Normalized)	12	3 J	*	*	*	4	*	7
PCBs	(µg/kg - Dry Weight)	130[3]	*	<20 U	110	<20 U	*	42	*
LPAHs	(mg/kg - OC Normalized)	370	150	*	*	*	0.42	*	12
LPAHs	(µg/kg - Dry Weight)	5200[3]	*	235	1219	<6.3 U	*	9	*
HPAHs	(mg/kg - OC Normalized)	960	243	*	*	*	5	*	72
HPAHs	(µg/kg - Dry Weight)	12000[3]	*	464	1786	<6.3 U	*	242	*
TBT	(mg/kg - OC Normalized)	76[4]	NA	*	*	*	NA	*	NA
TBT	(µg/kg - Dry Weight)	1335[5]	*	NA	NA	NA	*	NA	*
Bioassay	-	SMS[6]	NA	NA	NA	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

Analytes	Units	Compliance Criteria[2]	Sampling Locations[1]						
			SMA 2						
			TSP-02-01[7]	TSP-02-02[7]	TSP-02-03	TSP-02-04	TSP-02-05	TSP-02-06	TSP-02-07
			10/24/2004	10/24/2004	9/27/2004	9/27/2004	10/4/2004	10/4/2004	10/13/2004
Metals									
Arsenic	(mg/kg)	57	NR	NR	34 J	4	12	6	5
Copper	(mg/kg)	390	NR	NR	86	17	47	49	21
Lead	(mg/kg)	450	NR	NR	61 J	10	32	20	12
Mercury	(mg/kg)	0.41	NR	NR	0.27 J	<0.06 U	0.28	**0.71**	0.18
Zinc	(mg/kg)	410	NR	NR	214	29	76	58	36
TOC	(%)	-	NR	NR	0.772	0.273	0.968	1.18	1.56
PCBs	(mg/kg - OC Normalized)	12	NR	NR	*	*	*	<2 U	3
PCBs	(µg/kg - Dry Weight)	130[3]	NR	NR	74	<19 U	42	*	*
LPAHs	(mg/kg - OC Normalized)	370	NR	NR	*	*	*	3	4
LPAHs	(µg/kg - Dry Weight)	5200[3]	NR	NR	225	57	180	*	*
HPAHs	(mg/kg - OC Normalized)	960	NR	NR	*	*	*	10	19
HPAHs	(µg/kg - Dry Weight)	12000[3]	NR	NR	1915	367	825	*	*
TBT	(mg/kg - OC Normalized)	76[4]	NR	NR	*	*	*	<0.45 U	0.77
TBT	(µg/kg - Dry Weight)	1335[5]	NR	NR	150 J	<5.6 U	58	*	*
Bioassay	-	SMS[6]	Pass	**Fail**	NA	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

Analytes	Units	Compliance Criteria[2]	Sampling Locations[1]						
			SMA 2		SMA 3				
			TSP-02-08	TSP-02-09	TSP-03-01	TSP-03-02	TSP-03-03	TSP-03-04	TSP-03-05
			10/13/2004	10/13/2004	2/11/2005	2/11/2005	12/8/2004	12/9/2004	2/11/2005
Metals									
Arsenic	(mg/kg)	57	8	6	7	7	7	<7 U	7
Copper	(mg/kg)	390	59	41	29	62	81	31	46.8
Lead	(mg/kg)	450	31	14 J	5	27	19 J	6	69
Mercury	(mg/kg)	0.41	**0.48**	0.18	0.07	**0.85**	0.35	0.08	0.38
Zinc	(mg/kg)	410	72	48	37	76.8	66	42	142
TOC	(%)	-	1.59	2.78	0.944	0.768	0.727	0.738	0.773
PCBs	(mg/kg - OC Normalized)	12	2	2	*	*	*	*	*
PCBs	(μg/kg - Dry Weight)	130[3]	*	*	<20 U	32	108 J	<20 U	17 J
LPAHs	(mg/kg - OC Normalized)	370	10	6	*	*	*	*	*
LPAHs	(μg/kg - Dry Weight)	5200[3]	*	*	<6.6 U	336	414	41	354
HPAHs	(mg/kg - OC Normalized)	960	44	16	*	*	*	*	*
HPAHs	(μg/kg - Dry Weight)	12000[3]	*	*	35	1872	1409 J	187	1446
TBT	(mg/kg - OC Normalized)	76[4]	6	0.86	*	*	*	*	*
TBT	(μg/kg - Dry Weight)	1335[5]	*	*	<4.3 U	36	79	5	7.6
Bioassay	-	SMS[6]	NA	NA	NA	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

Analytes	Units	Compliance Criteria[2]	Sampling Locations[1]						
			SMA 3						
			TSP-03-06	TSP-03-07	TSP-03-08	TSP-03-09	TSP-03-10	TSP-03-11	TSP-03-12
			2/23/2005	2/11/2005	12/13/2004	12/13/2004	12/22/2004	12/13/2004	12/13/2004
Metals									
Arsenic	(mg/kg)	57	<6 U	14	12	8	7	<7 U	<7 U
Copper	(mg/kg)	390	47	112	30	59	33	16	13
Lead	(mg/kg)	450	17	48	15	16	9	4	9
Mercury	(mg/kg)	0.41	**1.04**[8]	**0.66**	<0.07 U	0.22	0.07	<0.07 U	<0.06 U
Zinc	(mg/kg)	410	42	109	74	65	56	29	26
TOC	(%)	-	0.882	1.22	0.388	0.791	1.07	0.742	1.6
PCBs	(mg/kg - OC Normalized)	12	*	6 J	*	*	<2 U	*	<1 U
PCBs	(μg/kg - Dry Weight)	130[3]	<20 U	*	20	74	*	<20 U	*
LPAHs	(mg/kg - OC Normalized)	370	*	24	*	*	2	*	<0.41 U
LPAHs	(μg/kg - Dry Weight)	5200[3]	16	*	163	38	*	15	*
HPAHs	(mg/kg - OC Normalized)	960	*	103	*	*	14	*	<0.41 U
HPAHs	(μg/kg - Dry Weight)	12000[3]	410	*	78	251	*	105	*
TBT	(mg/kg - OC Normalized)	76[4]	*	34.43	*	*	<0.38 U	*	<0.27 U
TBT	(μg/kg - Dry Weight)	1335[5]	<4.2 U	*	<4.3 U	10	*	<4.1 U	*
Bioassay	-	SMS[6]	NA	NA	NA	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

Analytes	Units	Compliance Criteria[2]	Sampling Locations[1]						
			SMA 3	SMA 4					
			TSP-03-13	TSP-04-01	TSP-04-02	TSP-04-03	TSP-04-04	TSP-04-05	TSP-04-06
			12/22/2004	1/20/2005	2/4/2005	1/24/2005	1/7/2005	1/20/2005	1/7/2005
Metals									
Arsenic	(mg/kg)	57	<6 U	<6 U	7	14	8	7	<7 U
Copper	(mg/kg)	390	10	84	25	90	55	54	17
Lead	(mg/kg)	450	3	10	5	26	17	14	<3 U
Mercury	(mg/kg)	0.41	<0.04 U	0.24	<0.06 U	0.21	0.25	0.17	<0.07 U
Zinc	(mg/kg)	410	22	53	32	100	48	50	23
TOC	(%)	-	0.869	0.404	0.592	0.509	1.04	0.809	0.703
PCBs	(mg/kg - OC Normalized)	12	*	*	*	*	<1.83 U	*	*
PCBs	(μg/kg - Dry Weight)	130[3]	<19 U	<20 U	<19 U	87[9]	*	<20 U	<19 U
LPAHs	(mg/kg - OC Normalized)	370	*	*	*	*	10.57	*	*
LPAHs	(μg/kg - Dry Weight)	5200[3]	11	80	133	131	*	12	<6 U
HPAHs	(mg/kg - OC Normalized)	960	*	*	*	*	48	*	*
HPAHs	(μg/kg - Dry Weight)	12000[3]	25	204	27	511	*	125	<6 U
TBT	(mg/kg - OC Normalized)	76[4]	*	*	*	*	7	*	*
TBT	(μg/kg - Dry Weight)	1335[5]	<4.3 U	92 J	6	150	*	34	<4 U
Bioassay	-	SMS[6]	NA	NA	NA	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

Analytes	Units	Compliance Criteria2	Sampling Locations[1]				
			SMA 4				
			TSP-04-07	TSP-04-08	TSP-04-09	TSP-04-10	TSP-04-11
			1/12/2005	2/4/2005	1/20/2005	1/14/2005	1/14/2005
Metals							
Arsenic	(mg/kg)	57	<6 U	7	<6 U	8.82	12
Copper	(mg/kg)	390	31	25	18	45.3	120
Lead	(mg/kg)	450	5	3	4	13	17
Mercury	(mg/kg)	0.41	<0.06 U	<0.07 U	0.3	0.31	0.10
Zinc	(mg/kg)	410	31	30	31	50	122
TOC	(%)	-	0.727	0.554	0.904	1.37	0.863
PCBs	(mg/kg - OC Normalized)	12	*	*	*	<1 U	*
PCBs	(μg/kg - Dry Weight)	130[3]	<20 U	<19 U	<20 U	*	<20 U
LPAHs	(mg/kg - OC Normalized)	370	*	*	*	4	*
LPAHs	(μg/kg - Dry Weight)	5200[3]	20	<6 U	28	*	16
HPAHs	(mg/kg - OC Normalized)	960	*	*	*	28	*
HPAHs	(μg/kg - Dry Weight)	12000[3]	279	<6 U	62 J	*	177
TBT	(mg/kg - OC Normalized)	76[4]	*	*	*	1	*
TBT	(μg/kg - Dry Weight)	1335[5]	4	<4.1 U	5	*	90
Bioassay	-	SMS[6]	NA	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

Analytes	Units	Compliance Criteria[2]	Sampling Locations[1]			
			SMA 5			
			TSP-05-01	TSP-05-02	TSP-05-03	TSP-05-04
			11/30/2004	11/30/2004	2/21/2005	11/30/2004
Metals						
Arsenic	(mg/kg)	57	<7 U	10	<7 U	7
Copper	(mg/kg)	390	16	29	31	21
Lead	(mg/kg)	450	4	13	3	6
Mercury	(mg/kg)	0.41	<0.05 U	<0.1 U	<0.07 U	<0.05 U
Zinc	(mg/kg)	410	26	78	34	43
TOC	(%)	-	1.25	0.993	0.840	0.786
PCBs	(mg/kg – OC Normalized)	12	<2 U	*	*	*
PCBs	(μg/kg – Dry Weight)	130[3]	*	<20 U	<19 U	<20 U
LPAHs	(mg/kg – OC Normalized)	370	1	*	*	*
LPAHs	(μg/kg – Dry Weight)	5200[3]	*	<7 U	38	<7 U
HPAHs	(mg/kg – OC Normalized)	960	<1 U	*	*	*
HPAHs	(μg/kg – Dry Weight)	12000[3]	*	<7 U	38	<7 U
TBT	(mg/kg – OC Normalized)	76[4]	<0.47 U	*	*	*
TBT	(μg/kg – Dry Weight)	1335[5]	*	20	<4 U	<5.9 U
Bioassay	-	SMS[6]	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

			Sampling Locations[1]				
			SMA 6				
			TSP-06-01	TSP-06-05	TSP-06-06	TSP-06-07	TSP-06-08
Analytes	**Units**	**Compliance Criteria[2]**	**9/9/2005**	**9/14/2005**	**9/27/2005**	**9/27/2005**	**9/27/2005**
Metals							
Arsenic	(mg/kg)	57	13	10	11	21	30
Copper	(mg/kg)	390	40	26	43	111	**569**
Lead	(mg/kg)	450	24	97	116	227	**454**
Mercury	(mg/kg)	0.41	**0.64**	**0.50**	**0.92**	**1.56**	**12.60**
Zinc	(mg/kg)	410	78	84 J	215	334	**485**
TOC	(%)	-	0.60	2.35	1.20	1.28	1.34
PCBs	(mg/kg - OC Normalized)	12	*	3	<2 U	<1 U	4.78
PCBs	(µg/kg - Dry Weight)	130[3]	<19 U	*	*	*	*
LPAHs	(mg/kg - OC Normalized)	370	*	127	325	**598**	**443**
LPAHs	(µg/kg - Dry Weight)	5200[3]	4,208	*	*	*	*
HPAHs	(mg/kg - OC Normalized)	960	*	145	286	919	**2,114**
HPAHs	(µg/kg - Dry Weight)	12000[3]	2,078	*	*	*	*
TBT	(mg/kg - OC Normalized)	76[4]	*	<0.2 U	<0.3 U	<0.3 U	<0.3 U
TBT	(µg/kg - Dry Weight)	1335[5]	<3.7 U	*	*	*	*
Bioassay	-	SMS[6]	NA	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

Analytes	Units	Compliance Criteria[2]	Sampling Locations[1]						
			SMA 7						
			TSP-07-01	TSP-07-02	TSP-07-03	TSP-07-04	TSP-07-05	TSP-07-06	TSP-07-07
			9/30/2005	9/30/2005	10/12/2005	10/12/2005	9/30/2005	10/12/2005	9/29/2005
Metals									
Arsenic	(mg/kg)	57	17	11	8	8	10	<6 U	53
Copper	(mg/kg)	390	87	31	15	13	48	9	96
Lead	(mg/kg)	450	49	14	<3 U	<3 U	31	<2 U	95
Mercury	(mg/kg)	0.41	**0.43**	0.25	<0.06 U	<0.06 U	**0.53**	<0.06 U	0.35
Zinc	(mg/kg)	410	118	45	26	24	68	22	378
TOC	(%)	-	1.07	0.896	1.93	3.9	0.353	0.269	0.457
PCBs	(mg/kg - OC Normalized)	12	6	*	<1.0 U	<0.49 U	*	*	*
PCBs	(μg/kg - Dry Weight)	130[3]	*	<19 U	*	*	52	<20 U	100
LPAHs	(mg/kg - OC Normalized)	370	52	*	0.44	<0.17 U	*	*	*
LPAHs	(μg/kg - Dry Weight)	5200[3]	*	120	*	*	550	<6.0 U	420
HPAHs	(mg/kg - OC Normalized)	960	257	*	1.2	0.26	*	*	*
HPAHs	(μg/kg - Dry Weight)	12000[3]	*	585	*	*	1,448	<6.0 U	2,783
TBT	(mg/kg - OC Normalized)	76[4]	24	*	<0.18 U	<0.09 U	*	*	*
TBT	(μg/kg - Dry Weight)	1335[5]	*	14	*	*	48	<3.4 U	33
Bioassay	-	SMS[6]	NA	NA	NA	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

Analytes	Units	Compliance Criteria[2]	Sampling Locations[1]						
			SMA 8						
			TSP-08-01	TSP-08-02	TSP-08-03	TSP-08-04	TSP-08-05	TSP-08-06	TSP-08-07
			10/18/2005	10/28/2005	10/18/2005	10/28/2005	10/28/2005	10/20/2005	10/28/2005
Metals									
Arsenic	(mg/kg)	57	8	7	15	10	10	29	34
Copper	(mg/kg)	390	19	19	30	64	25	65	66
Lead	(mg/kg)	450	8	23	21	33	10	128	121
Mercury	(mg/kg)	0.41	<0.06 U	<0.06 U	0.06	0.12	0.15	0.22	**0.43**
Zinc	(mg/kg)	410	73	51 J	84	74 J	44 J	237	270 J
TOC	(%)	-	0.866	0.672	0.177	0689	0.56	0.596	0.387
PCBs	(mg/kg - OC Normalized)	12	*	*	*	*	*	*	*
PCBs	(µg/kg - Dry Weight)	130[3]	<33 U	<20 U	<34 U	47	<19 U	53	30
LPAHs	(mg/kg - OC Normalized)	370	*	*	*	*	*	*	*
LPAHs	(µg/kg - Dry Weight)	5200[3]	57	213	37	**9,219**	681	644	94
HPAHs	(mg/kg - OC Normalized)	960	*	*	*	*	*	*	*
HPAHs	(µg/kg - Dry Weight)	12000[3]	448	639	484	7,715	866	2,181	926
TBT	(mg/kg - OC Normalized)	76[4]	*	*	*	*	*	*	*
TBT	(µg/kg - Dry Weight)	1335[5]	<6 U	<4 U	43	6	<4 U	12	<4 U
Bioassay	-	SMS[6]	NA	NA	NA	NA	NA	NA	NA

Table 3.1
Final Progress Sampling Results

Analytes	Units	Compliance Criteria[2]	Sampling Locations[1]			
			SMA 8	SMA 9		
			TSP-08-08	TSP-09-01	TSP-09-02	TSP-09-03
			11/16/2005	11/11/2005	11/2/2005	11/2/2005
Metals						
Arsenic	(mg/kg)	57	<7 U	<7 U	<7 U	25
Copper	(mg/kg)	390	27	12	25	66
Lead	(mg/kg)	450	4	4	4	46
Mercury	(mg/kg)	0.41	<0.05 U	<0.06 U	<0.05 U	0.38
Zinc	(mg/kg)	410	32	26	30	167
TOC	(%)	-	0.614	0.832	1.08	0.931
PCBs	(mg/kg - OC Normalized)	12	*	*	<2 U	*
PCBs	(µg/kg - Dry Weight)	130[3]	<20 U	<18 U	*	<20 U
LPAHs	(mg/kg - OC Normalized)	370	*	*	1	*
LPAHs	(µg/kg - Dry Weight)	5200[3]	<6 U	146	*	99
HPAHs	(mg/kg - OC Normalized)	960	*	*	3	*
HPAHs	(µg/kg - Dry Weight)	12000[3]	13	382	*	836
TBT	(mg/kg - OC Normalized)	76[4]	*	*	<0.3 U	*
TBT	(µg/kg - Dry Weight)	1335[5]	<4 U	<3.4 U	*	<3.7 U
Bioassay	-	SMS[6]	NA	NA	NA	NA

Notes:

*	Sample result not compared to compliance criteria (dependent on TOC value).
NA	Analysis not performed (per RASAP requirements).
NR	Chemical analysis not reported due to results being superceded by bioassay results.
U	Compound undetected at the reported concentration.
1	Sampling locations based on RASAP Figure 5.1.
2	Compliance criteria based on SQS chemical criteria per Washington State Sediment Management Standards (SMS; Chapter 173-204 WAC), unless otherwise noted.
3	Compliance criteria based on Lowest Apparent Effects Threshold (LAET) chemical criteria per "1988 Update and Evaluation of Puget Sound AET" (Barrick, Becker, Brown, Beller, and Pastorak) where total organic carbon value is less than 1%.
4	Compliance criteria based on confirmational number stated in the 2002 Explanation of Significant Differences.
5	Compliance criteria based on the dry weight concentration is used when the total organic carbon value is less than 1%.
6	Compliance criteria based on SMS Bioassay Testing Results.
7	Results are for a sediment composite sample collected in the vicinity of the sample location for bioassay testing.
8	Sample re-analyzed for mercury. Initial concentration was 5.13 ppm.
9	Sample re-analyzed for PCBs. Initial concentration was 136 ppb.

Bold indicates analytical result exceeds compliance criteria.

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Operations, Maintenance, and Monitoring Plan
Todd Shipyards
Sediment Operable Unit

Figure B.1
Final Surface Sediment Verification Stations

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MXD NAME: \\Sam\Data\projects\TODD-NPL\GIS\RACR - Figure 3.1 Sedi Verif Stns.mxd

Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Appendix C
Coast and Harbor Engineering Technical Memorandum—Todd Shipyard Sediment Operable Unit Superfund Cleanup Project

FINAL

Technical Memorandum
Todd Shipyard Sediment Operable Unit Superfund Cleanup Project

1. Introduction

This memorandum summarizes the results of the coastal engineering analysis conducted by Coast & Harbor Engineering, Inc. (CHE) under contract to Floyd/Snider in support of the Todd Shipyard Sediment Operable Unit Superfund Cleanup Project design work. The objective of the analysis includes the following:

- Develop design criteria for the habitat mix backfill layer bench and submerged riprap steep slope layer design,
- Evaluate stability of the specified habitat mix backfill layer design and develop improvements if required,
- Evaluate stability of the proposed rock buttress fill design and develop improvements if required,
- Evaluate stability of the proposed submerged riprap slope transition to habitat mix backfill layer bench design details and develop improvements if required; and,
- Develop recommendations and assist with the design of the south and north terminus of the project.

The coastal engineering analysis and recommendations contained within this Technical Memorandum are based on a statistical analysis of oceanographic data and the results of numerical modeling of wind waves and vessel wake generation, propagation, and interaction with the bottom slope and bottom surface sediment. The recommendations of this Technical Memorandum also incorporate practical experience from similar projects, including TRC Sediment Remediation Lockheed Shipyard No. 1 project. The project features evaluated as a part of the coastal engineering analysis work are presented in Figure 1.

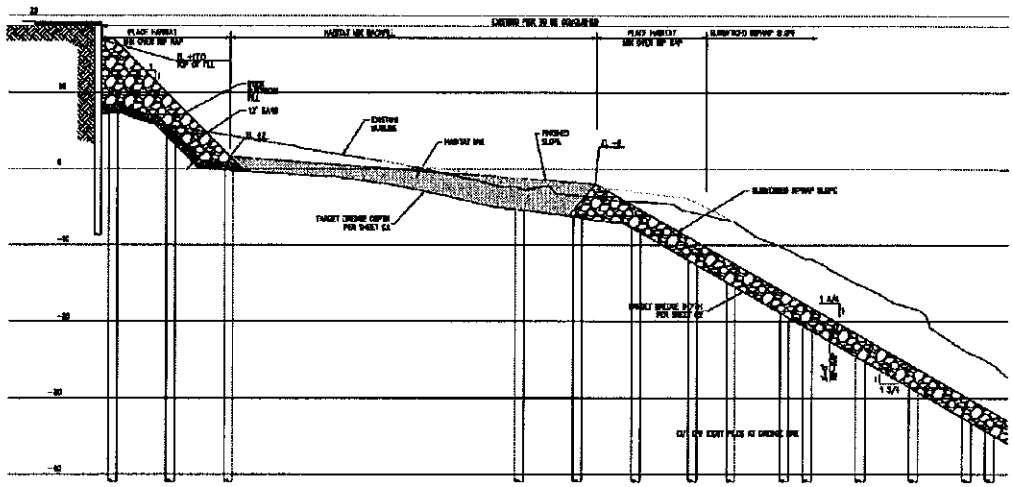


Figure 1 – Project Site Features from Drawing Sheet C11

2. Project Design Criteria

Two major factors controlling stability and durability of the project, wind waves and vessel wakes, were originally considered for the analysis and evaluation. Table 1 presents the results of wind wave extreme analysis and shows wave heights and periods of deepwater waves at the project site. The extremal analysis was conducted based on twenty years of wind data obtained from National Data Buoy Center C-MAN Station WPOW1 at West Point, WA. Two extreme storm events, 5-year and 25-year return periods, were selected as the wind wave design criteria for the project. The 25-year wind wave design criterion is recommended for evaluation of the rock buttress fill and submerged riprap steep slope stability. The 5-year wind wave design criterion is recommended for evaluation of the habitat mix stability.

Table 1. Deep Water Wave Extreme Analysis and Recommended Tide Elevations

Tr (yr)	Wind Speed (knots)	Wave Height (feet)	Peak Period (sec)	Wave Dir (Deg N)	Tide (ft MLLW)
5	31.6	3.56	3.96	320	+11.38; 0.00; -4.20
10	33.4	3.85	4.10	320	+11.38; 0.00; -4.20
25	36.7	4.38	4.34	320	+11.38; 0.00; -4.20
50	37.3	4.48	4.38	320	+11.38; 0.00; -4.20
100	38.7	4.69	4.47	320	+11.38; 0.00; -4.20

Vessel wake design criteria was developed using previous Washington State Ferry wake study data, assuming that a Jumbo Class ferry sails at a distance of approximately 3,000 ft from the project site at a speed of 17 knots. The computed ferry wake parameters are shown in Table 2. The table also depicts the wind wave design criteria (extracted from Table 1) which show that the wind waves are the controlling criteria at the site for both the 5-year and 25-year return period events. Therefore, wind wave design criteria were selected as the criteria for conducting the coastal engineering analysis and design work on the project. The Mean Lower Low Water (MLLW) vertical datum was selected as the recommended datum for analysis and therefore all elevations presented herein are relative to the MLLW datum. Three stages of tide elevations were used as design criteria in combination with the wind wave design criteria as follows: +11.38 ft (MHHW tide elevation), 0.0 ft (MLLW tide elevation), and - 4.20 ft (Extreme Low Tide).

Table 2. Wind Wave and Vessel Wake Design Criteria

	Wave Height (feet)	Peak Period (sec)
Wind wave, 5-year return period	3.56	3.96
Wind wave, 25-year return period	4.38	4.34
Computed ferry wake	1.5	3.6

3. Numerical Modeling and Engineering Analysis

Two types of wave modeling were conducted to evaluate stability of the project and to develop recommendations for the project design parameters: STWAVE and RBREAK. STWAVE (US Army Corps of Engineers) 2-dimensional wave transformation model simulates wave refraction and diffraction during propagation from deep water to the project site.

STWAVE modeling was used to determine wave parameters at the project site and wave forces on slope, armor rock, and habitat mix backfill for the conditions seaward from the surf zone. An example of the modeling results using the STWAVE model for the 5-year return period storm event and a 0.0 ft elevation is shown in Figure 2. This graphic depicts the wave height distribution, in plan view, at the project site. The distribution of wave conditions along cross section C11 (see design plans) at the project site is shown in Figure 3. This figure shows the distribution of wave heights along the cross section for the same storm event (5-year return period and 0.0 ft tide elevation).

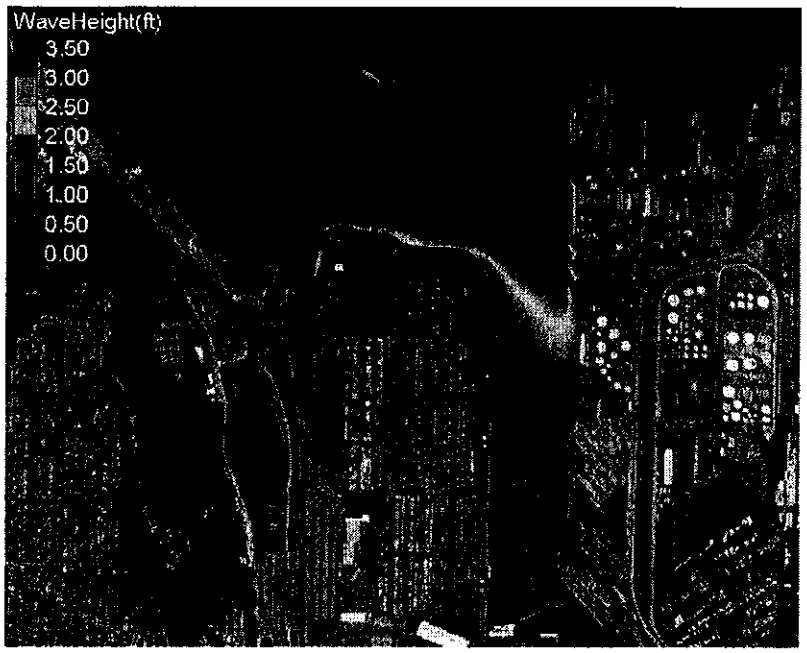


Figure 2 - STWAVE wave transformation modeling results. (5-year return period storm, Tide elevation 0.0 ft)

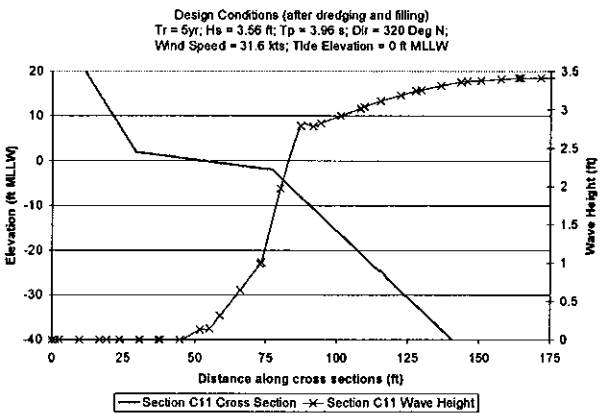


Figure 3 - Cross Section C11, STWAVE modeling results, Wave storm 5-year return period, Tide elevation 0.0 ft

RBREAK (Kobayasi and Poff, 1994), a 1-dimensional non-linear wave transformation model that simulates wave breaking and swashing on the surf zone, was also used to determine wave parameters at the project site for the purpose of evaluating habitat mix layer and riprap size requirements. The RBREAK modeling results were used to calculate wave forces and swash velocities in the surf zone. An example of the RBREAK modeling results for the 5-year return period storm event at a 0.0 ft elevation is shown in

Figure 4. Numerical wave modeling, using STWAVE and RBREAK, was conducted for all combinations of wave parameters and tide elevations discussed above. A total of six modeling scenarios were simulated using each of the models.

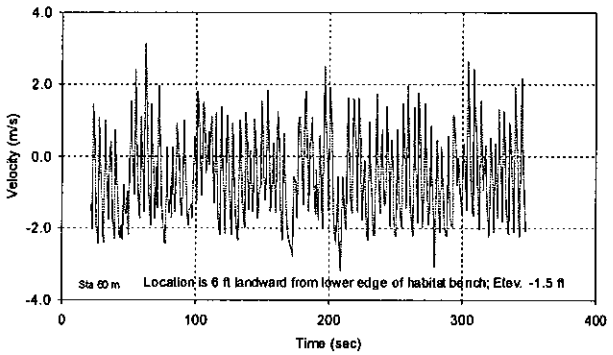


Figure 4 - RBREAK modeling results, Cross Section C11, Bottom Elevation -1.5 ft, Wave storm 5-year return period, Tide elevation 0.0 ft

Wave height and period and wave swash velocities obtained from the numerical modeling results were input to standard coastal engineering computational methods in order to evaluate the stability of the project elements (rock buttress, habitat mix, and submerged riprap slope). Where the results of computational methods indicated that wave induced forces exceeded the threshold for stability for each project element (habitat mix, rock buttress, or submerged riprap slope) an evaluation of alternative materials was conducted and recommendations were developed.

Wave swash velocities were computed using RBREAK to test the design criteria. The model was used to compute velocities at varying locations along a typical profile between elevation -2ft and +2ft at a tide level of MLLW. The model predicted wave generated current velocity was computed to be equal to 2 m/sec (6.6 ft/sec) at MLLW. Comparing the wave generated velocity to the threshold velocity (Ackers and White, 1973) and the corresponding particle size shows that material finer than 1-inch will be mobilized in the 5-year storm. Figure 5 shows the gradation of currently specified habitat mix superimposed to the threshold stability criteria (vertical red line shown on Figure 5). The figure shows that most fractions of the existing habitat mix gradation are located below the criteria for stability. It implies that this material would likely be eroded and removed out of the project area during the design storm event. Figure 4 also shows the alternative materials that could be used for the project and exhibit greater stability for the coastal processes present at the project site. Based on the above analysis the recommendations for the project design were developed and presented below.

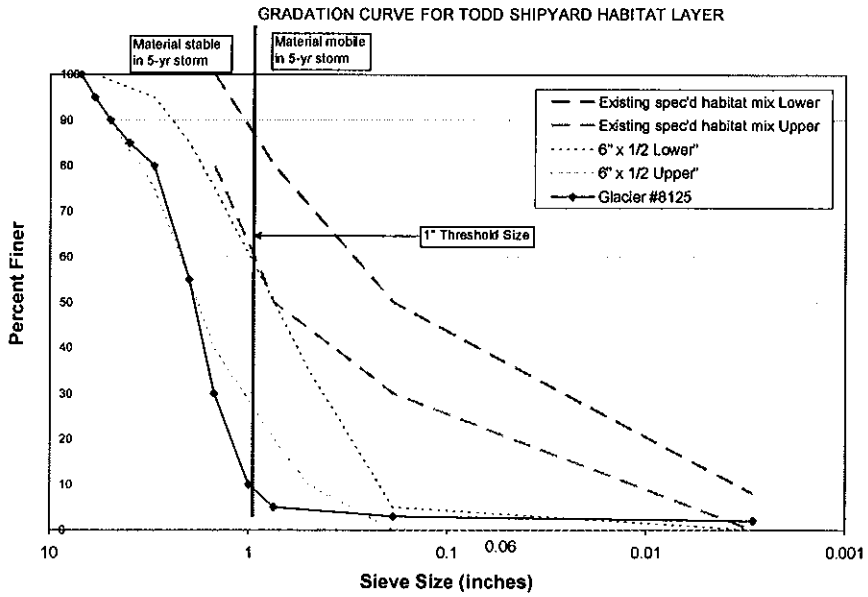


Figure 5 – Evaluation of gravel gradations for Habitat Mix

4. Design Recommendations

4.1. Buttress Rock

The current design indicates a buttress fill constructed of WSDOT Light Loose Riprap at variable slopes of 1.75H:1V and 1H:1V, variable crest elevations of +9.0 ft MLLW and +17.0 ft MLLW and a constant toe elevation of +2.0 ft MLLW. Light Loose Riprap is specified to be 20% to 90% between 300 lbs to 1 ton and 15% to 80% between 50 lbs to 1 ton. The analysis has shown that this type of design and gradation doesn't provide sufficient control and certainty of the required median stone size.

Two sets of rock size and corresponding gradations were developed for each of the currently designed buttress fill front slopes (1H:1V and 1.75H:1V). The minimum W50 stone size for the 1H:1V slope was computed to be 675 lbs and the minimum W50 stone size for the 1.75H:1V slope was computed to be 400 lbs. To reduce construction cost and aid in ease of construction, it is recommended to develop a single gradation for the entire buttress fill work. A change in slope or selection of the larger gradation for all locations would be required to standardize the gradation for the entire rock fill work. See Tables 3 and 4 for the recommended rock gradations based on the rock sizing results.

Table 3. Computed Rock Gradation for 1H:1V Slope

Stone Weight (lbs.)	Percent Smaller by Weight
2,500 to 4,000	100
675 to 1,000	50
85 to 125	0

Table 4. Computed Rock Gradation for 1.75H:1V Slope

Stone Weight (lbs.)	Percent Smaller by Weight
1,600 to 2,500	100
400 to 600	50
50 to 75	0

4.2. Habitat Mix Backfill

The current construction plans indicate the placement of a habitat mix backfill layer between the toe of the buttress fill (elevation +2 ft) and the top of the submerged riprap slope (elevation -2 ft). The originally proposed habitat mix backfill gradation is presented in Table 4.

Table 4. Habitat Mix Backfill Sediment Sizes

Sieve Sizes	PERCENT PASSING	
	Upper Limit	Lower Limit
$1^1/_2$ – inch	100	80
$^3/_4$ - inch	80	50
#4	50	30
#200	8	0

Based on the results of our analysis, the currently specified Habitat Mix Backfill gradation will not be stable at the project slopes and elevations and would be washed away during the design storm event (see Figure 5 above). Preliminary results of our analysis were presented to Floyd/Snider on August 29, 2005 which included the analysis results for various courser gradations from previous similar projects. An alternative gradation of material (Glacier Northwest #8125 gradation) was provided by Floyd/Snider for CHE to evaluate. Our analysis indicates that a habitat mix layer constructed with a revised gradation composed of gravel/cobble type material (similar to Glacier NW #8125 gradation) would be dynamically stable and satisfies the design criteria described herein. Figure 5 above shows that more than 95% of this material complies with the stability

criteria. The recommended size gradation of the revised habitat mix gradation gravel/cobble material is listed in Table 5.

Table 5. Revised Habitat Mix Backfill Gradation

Sieve Size	Glacier NW #8125 Percent Passing (by Weight)
7"	100
6"	95
5"	90
4"	85
3"	80
2"	55
1 ½"	30
1"	10
3/4"	5
#4 Sieve	3

To preclude migration of sediment along the shoreline and loss of habitat mix to adjacent deep bottom slopes a terminal sill feature will be required at both the north and south end of the site. The sill should be constructed of riprap having similar size gradation as the rock buttress fill. Conceptual cross section of the sill is shown in Figure 6.

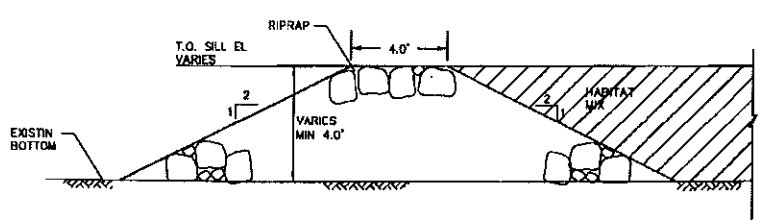


Figure 6 - Terminal Sill feature conceptual cross section

4.3. Steep Slope Rock

The transition point between the habitat mix layer and the submerged riprap slope (near elevation -2 ft) should be modified to assure the stability of the slope at this location and improve the retention of mobile habitat mix layer particles. The revised transition should consist of a minimum riprap top width of 5 feet, top

elevation at -1 ft, and a courser riprap gradation similar to the rock buttress fill. Figure 7 shows the recommended configuration of the transition zone.

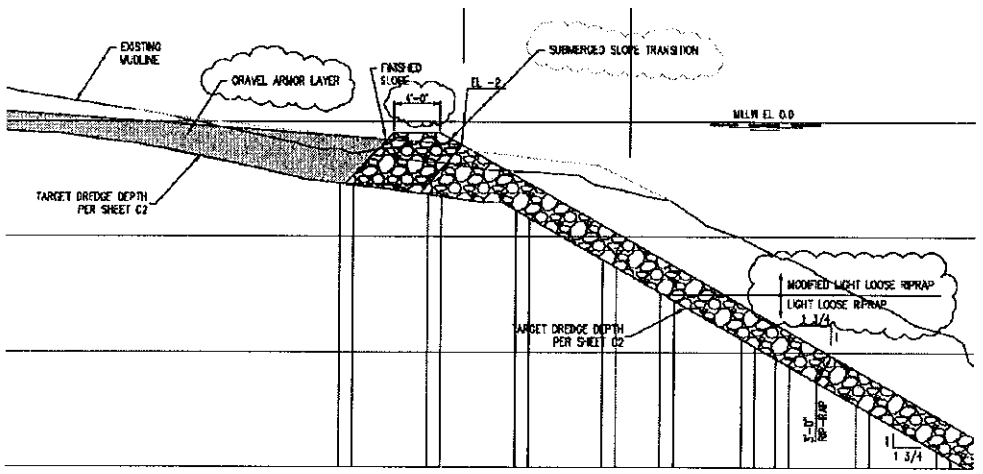


Figure 7 – Habitat Mix layer to submerged riprap slope transition detail

5. References

Ackers, Peter and William Rodney White 1973. Sediment Transport: New Approach and Analysis. Journal of Hydraulics Division, Proceedings of American Society of Civil Engineers, Vol. 99, No. HY 11, p. 2041- 2060.

CEDAS software 2001. Coastal Engineering Design and Analysis System, Veri-Tech, Inc., Vicksburg, Mississippi.

Kobayashi, N. and M.T. Poff. June, 1994. Numerical Model RBreak2 for Random Waves on Impermeable Coastal Structures and Beaches, Research Report #CACR-94-12.

Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Appendix D
Coast and Harbor Engineering Technical Memorandum—Todd Shipyard Severe Storm Event Criteria and Method

FINAL

COAST & HARBOR
ENGINEERING

Technical Memorandum

Todd Shipyard Severe Storm Event Criteria and Method

This memorandum provides criteria for a severe storm event of extreme magnitude at the Todd Shipyard Sediment Operable Unit, and a method to determine if an actual storm event meets the criteria. The severe storm event is considered an event that potentially may damage the armor layer and result in significant loss of fish-mix habitat from the Todd Shipyard Sediment Operable Unit. Typically, this event equals or exceeds a wind wave storm that is used as the design criteria for the project design and construction.

Based on analysis and numerical modeling, Coast & Harbor Engineering, Inc. (CHE) has determined a 25-year return period wave storm from a northerly direction as the design criteria for stability of the armor layer at the Todd Pacific Shipyard Sediment Operable Unit Project (See Technical Memorandum-Todd Shipyard Sediment Operable Unit Superfund Cleanup Project September 9, 2005). CHE computed the 25-year wind wave storm parameters, including wave height, period, direction, and corresponding wind speed, as shown in Table 1. Figure 1 shows the direction of the wind storm event corresponding to this 25-year return period event.

Table 1. Design Wind and Wave for Habitat Mix Backfill Layer

Return Period (yr)	Wind Speed (kts)	Wave Height (ft)	Peak Period (sec)	Wave Direction (°T)
25	36.7	4.4	4.3	320

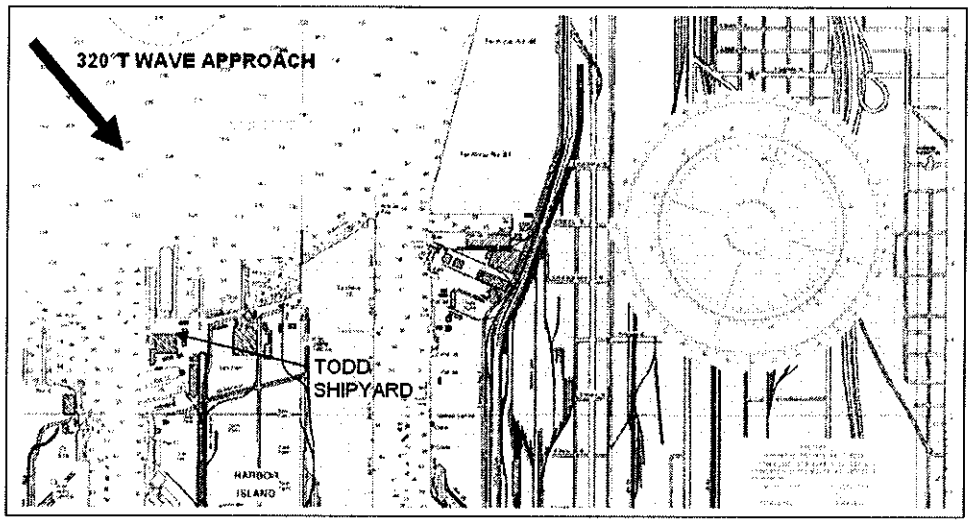


Figure 1 - Wave Approach Direction

The method for determining if an actual storm meets the severe storm event criteria is based on comparison of the measured actual storm wind speed from a northerly direction to the wind speed criteria for the design storm in Table 1. If the measured wind speed from a northerly direction equals or exceeds 36.7 knots, then the storm event is defined as a severe storm event of extreme magnitude at the Todd Pacific Shipyard Sediment Operable Unit project.

The design wave storm event was developed based on wind data from the National Data Buoy Center (NDBC) C-MAN (Coastal-Marine Automated Network) Station WPOW1 at West Point, WA. Location of the NDBC measuring station is shown in Figure 2. Wind observations for West Point are reported every hour for 2-minute duration winds, with wind directions using the 16-point compass (N, NNE, NE, etc.) and wind speeds to the nearest whole knot. The West Point measured wind speed and directions are available at the following Internet site: http://www.ndbc.noaa.gov/station_page.php?station=wpow1

The data from this station were compiled for the period 1984 to 2005 and statistically processed. Wind speed of 2, 5, 10, 25, 50, and 100 years return period events were computed for all directions and are shown in Figure 3. Dashed area in the figure corresponds to wind directions that generate waves at the project area.

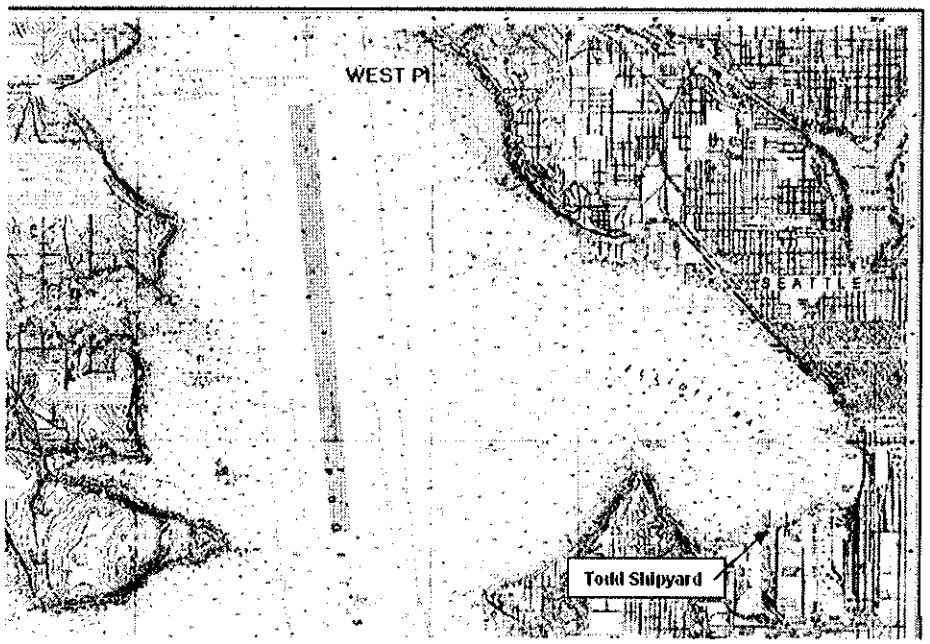


Figure 2 - West Point NOAA C-MAN Station

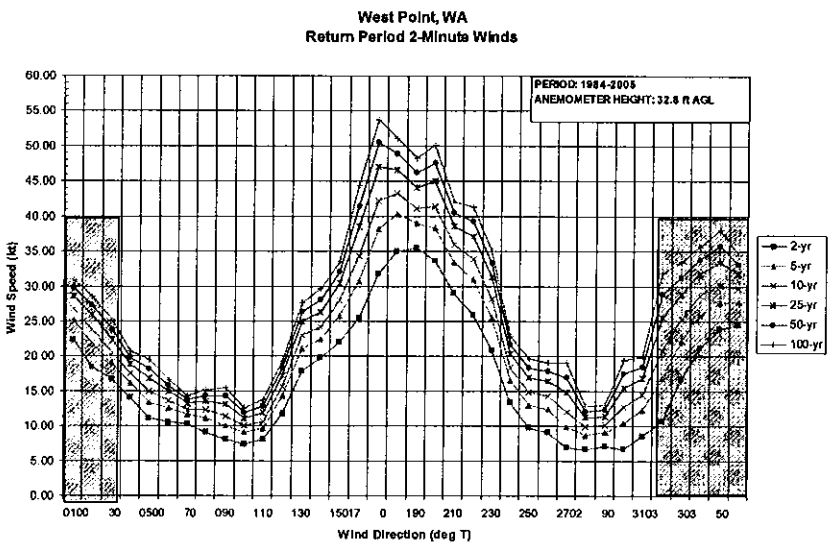


Figure 3, Wind Statistics at West Pt. Station

The procedure for defining whether the actual storm event falls into the category of a severe storm event for the Todd Shipyard Sediment Operable Unit project consists of the following three steps:

- Step1 - Acquire sustained wind speed (duration longer then 2 minutes) and direction from West Pt. NDBC station (see web link above).

- Step 2 – Determine maximum sustained wind speeds from the segment of directions 310-030 degrees true north (NW-NNE) for the period of minimum 1 hour.
- Step 3 - Compare wind speeds (those that have direction between 310-030 degrees or NW-NNE) to wind speed criteria 36.7 knots. Storm is defined as a severe storm event of extreme magnitude at the Todd Shipyard Sediment Operable Unit if the measured wind speed equals or exceeds 36.7 knots.

Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Appendix E

Todd Process Memorandum: Northeast Shoreline Sediment Cap Institutional Controls

FINAL

	Document Type: PROCESS MEMORANDUM	Document #:	Revision Date:	
	Document Name: **NORTHEAST SHORELINE SEDIMENT CAP INSTITUTIONAL CONTROLS**		Replaces: N/A	Dated: 10/22/2007
Process Owner: Secretary & General Counsel		Responsible Managers:		Initials
Signature				

POLICY:

It is the policy of Todd Pacific Shipyards Corporation to conduct our operations in such a manner as to protect the Northeast Shoreline Sediment Cap and to monitor and maintain the riprap surface of this capped area to ensure that the riprap remains in place over the sand cap and is not eroded or otherwise disturbed.

SCOPE:

This policy applies to the institutional controls and monitoring and maintenance responsibilities regarding the Northeast Shoreline Sediment Cap. Additional details regarding the precautions and monitoring and maintenance activities that will be implemented at the sediment cap area are included in the Final Operation, Maintenance, and Monitoring Plan (OMMP) for remedial actions performed at the Todd Shipyards Sediment Operable Unit (TSSOU) (Floyd|Snider 2007a).

The Northeast Shoreline Sediment Cap was designed and constructed as a permanent containment cap and the objective for monitoring this cap is to insure that it continues to isolate elevated concentrations of chemicals of concern (COCs) in the underlying sediments from biological receptors (Floyd|Snider 2007b). For this cap, a 3-foot riprap layer was placed over a minimum 2–foot-thick isolation layer of gravelly sand material. Todd will maintain the riprap surface that armors and protects the sediment cap from erosion, as agreed to by USEPA and Todd during the 2004-2005 remedial action construction season.

RESPONSIBILITY:

The General Counsel shall maintain this policy, as these actions are required by federal consent decree under the Superfund program. This policy can not be modified without legal approval.

DETAIL PROCEDURE:

INSTITUTIONAL CONTROLS

The sediment cap in the Northeast Shoreline Area covers 0.34-acres (refer to Attachment 1). Todd will maintain the Northeast Shoreline Sediment Cap area in perpetuity, unless approval is received by both USEPA and Todd's General Counsel to cease maintenance. Long-term periodic monitoring will be required for this area to ensure that the slope is stable and riprap

remains in place. Response actions are required if long-term performance standards are not being met, as discussed further below. In addition, Todd will not excavate or dredge within this area without USEPA approval and appropriate planning.

PHYSICAL INTEGRITY MONITORING

This section summarizes the schedule and requirements physical integrity monitoring of the Northeast Shoreline Sediment Cap. Refer to the OMMP for further details on these monitoring events (Floyd|Snider 2007a).

Monitoring Schedule

Baseline and Long-term Routine Monitoring

Visual monitoring surveys by divers along a transect at the Northeast Shoreline Sediment Cap will begin with a baseline survey conducted in 2007 (Year 0) and will be followed by three monitoring surveys during Year 1, Year 2, and Year 4 following completion of the baseline survey. Assuming the baseline survey is completed in the fall of 2007, these monitoring events would occur in the fall of 2008, 2009, and 2011. If riprap remains in place after the first three monitoring events, a diver visual survey will be performed again in 5 years, at Year 9 following completion of the baseline survey (scheduled for 2016). If the riprap continues to remain in place, long-term monitoring of the Northeast Shoreline Sediment Cap will be considered complete and no further routine monitoring will be required. However, if monitoring indicates riprap is eroded or absent from the capped area, contingency actions will be implemented. USEPA can direct a different sequence of monitoring based on changed conditions at the site or or EPA can direct Todd to conduct supplementary monitoring to support EPA's five-year reviews.

Supplemental Monitoring

A supplemental visual monitoring survey of the Northeast Shoreline Sediment Cap will be completed after an earthquake that causes liquefaction of soils or building damage, at or near the site. Occurrence of an earthquake of magnitude 6.0 or greater in western Washington will trigger inquiry by the Port of Seattle and the City of Seattle officials as to whether local liquefaction or building damage occurred. This supplemental survey will occur during a low tide within 60 days of the earthquake or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner, and will consist of a visual survey of the riprap made from the shoreline. These earthquake supplemental surveys will occur throughout the lifetime of the cap.

A supplemental visual monitoring survey will also be completed following a severe storm event from a northerly direction that directly exposes the Northeast Shoreline Sediment Cap to sustained wind and wave action of an extreme magnitude. A severe storm for the cap is defined as a 25-year return period wave storm event and this corresponds to a storm where a sustained measured wind speed equals or exceeds 36.7 knots. To determine if a storm with this wind speed is occurring, the following procedures will be followed:

1. Acquire sustained wind speed (duration longer than 2 minutes) and direction from the National Data Buoy Center at West Point, Washington.

2. Determine maximum sustained wind speeds from the segment of directions 310-030 degrees true north (NW-NNE) for the period of a minimum of 1 hour.

3. Compare wind speeds (those that have direction between 310-030 degrees (NW-NNE)) to the wind speed criterion of 36.7 knots. A storm with a sustained wind speed equal to or greater than 36.7 knots, coming from 310-030 degrees true north, will trigger supplemental monitoring.

A technical memorandum providing additional details is included as Appendix D of the OMMP. The survey will consist of visual observation of the riprap from the shoreline adjacent to the Northeast Shoreline Sediment Cap during a low tide within 60 days following the storm or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner. Supplemental surveys due to severe storms will occur throughout the lifetime of the cap.

Monitoring Methods

Due to the size and weight of riprap placed on the slope in the Northeast Shoreline Sediment Cap area and the potential erosive forces that may act on the slope, it is highly unlikely that cap erosion will occur. However, physical integrity visual monitoring of the Northeast Shoreline Sediment Cap will be performed to determine whether the cap armoring remains in place over time. This monitoring will consist of a baseline visual survey and follow-on long-term monitoring visual surveys along a transect perpendicular to the shoreline across the cap area. Additionally, supplemental visual monitoring surveys of the sediment cap may be required due to earthquakes or severe storms.

The Manager of Safety/Quality/Environmental Compliance and the Facilities Manger will coordinate these monitoring events.

Baseline and Long-term Monitoring Surveys

Baseline and long-term visual monitoring along the Northeast Shoreline Sediment Cap transect will be accomplished both above and below the water because the capped area extends from approximately +17-feet MLLW to –40-feet MLLW. The diver/surveyor will observe the substrate conditions along the transect to verify the presence of riprap and an audio/video recording will be produced that documents the conditions of the substrate along the transect during the survey. Detailed diver observations and comments will be made at every 10-foot increment along the transect. If riprap has eroded or is not observed over a portion of the transect, additional transects will be surveyed to delineate the extent of the slope where riprap is eroded or absent. If riprap is eroded or absent, contingency actions will be performed, as summarized below.

Supplemental Monitoring Surveys

Supplemental visual monitoring surveys will be conducted on the Northeast Shoreline Sediment Cap for large earthquakes and severe storms. A supplemental survey will consist of a visual survey of the riprap made from the shoreline during low tide. If an adequate visual survey of the riprap from the shoreline cannot be made during low tide, then the visual survey will be completed by a diver using the same procedures described above for the baseline and long-term monitoring surveys. If riprap is noted to be eroded or absent in the capped area during this

visual shoreline survey or the diver transect survey, diver visual transects will then be made to delineate the extent of the riprap loss. Contingency actions will then be implemented.

CONTINGENCY PLANNING AND RESPONSE

In the event that physical integrity monitoring of the Northeast Shoreline Sediment Cap indicates that erosion of the riprap is occurring, Todd will implement the contingency process summarized in this section. Further details are included in the OMMP (Floyd|Snider 2007a).

Initial Contingency Screening

The initial contingency screening will be to delineate the area of concern and extent of erosion by conducting additional diver transects and by comparing the results of the survey to the baseline and previous survey events. The delineation of the extent of the impacted area will occur during the monitoring surveys, described above, if possible. If erosion of the riprap is observed Todd will notify USEPA within 15 days and provide USEPA written documentation within 30 days of receipt of the preliminary field survey observations.

Following notification, Todd will discuss the monitoring results and initial contingency screening results with USEPA to determine whether additional data collection is necessary to further determine the extent of the affected area. This additional data will be forwarded to USEPA within 30 days of receipt.

Evaluating Causes of Erosion

If there is any observed erosion of the riprap, a plan will be put in place to evaluate the cause of erosion. The possible causes of erosion will be evaluated based on the survey data relative to the baseline survey, any previous monitoring survey events, and available information about local vessel activity or storm events. Patterns of erosion and deposition will be visually analyzed. Identification of the likely cause of the erosion will affect decision making about potential operational controls and material replacement. Documentation of this evaluation and its resultant recommendation will be provided to the USEPA.

Contingency Action Planning

If riprap on the capped area has fully eroded to the sand layer located below it, Todd will submit a Contingency Action Planning Report to USEPA describing plans and contingency response actions to be taken to address these fully eroded riprap areas. Todd will submit this report to USEPA within 60 days of the submittal of the Physical Integrity Monitoring Report. The report will include evaluation of the extent and cause of the observed erosion, the proposed replacement plan and any required operational controls to be implemented, and an adjusted monitoring schedule. The need for further sampling and analysis in the capped area will be determined in conjunction with USEPA and if required will be included in the Contingency Action Planning Report.

Based on review of the Contingency Action Planning Report, USEPA and Todd will define, document, and schedule any additional sampling to occur and the contingency response to be performed.

RECORDS:

Draft reports for the baseline and routine long-term physical integrity monitoring surveys will be submitted to USEPA within 45 days after completion of the survey. The actual delivery data may be modified based on approval by USEPA in the event that additional sediment sampling or other contingency response actions become necessary. Final reports will be submitted pending USEPA's review 45 days after receipt and resolution of USEPA comments.

These reports will include an audio/video record documenting the visual observations and real-time comments made during the diver survey. Each report will also include a written evaluation of the data and provide comparisons to previous visual survey observations. Each report will also identify whether contingency actions are warranted in the capped areas.

Following a severe storm event or earthquake supplemental monitoring inspection, a supplemental monitoring report will be submitted to USEPA within 45 days. Reports will be similar in format and content to the routine physical integrity monitoring reports described above.

Documentation if contingency action is required is described earlier is this document.

ATTACHMENTS:

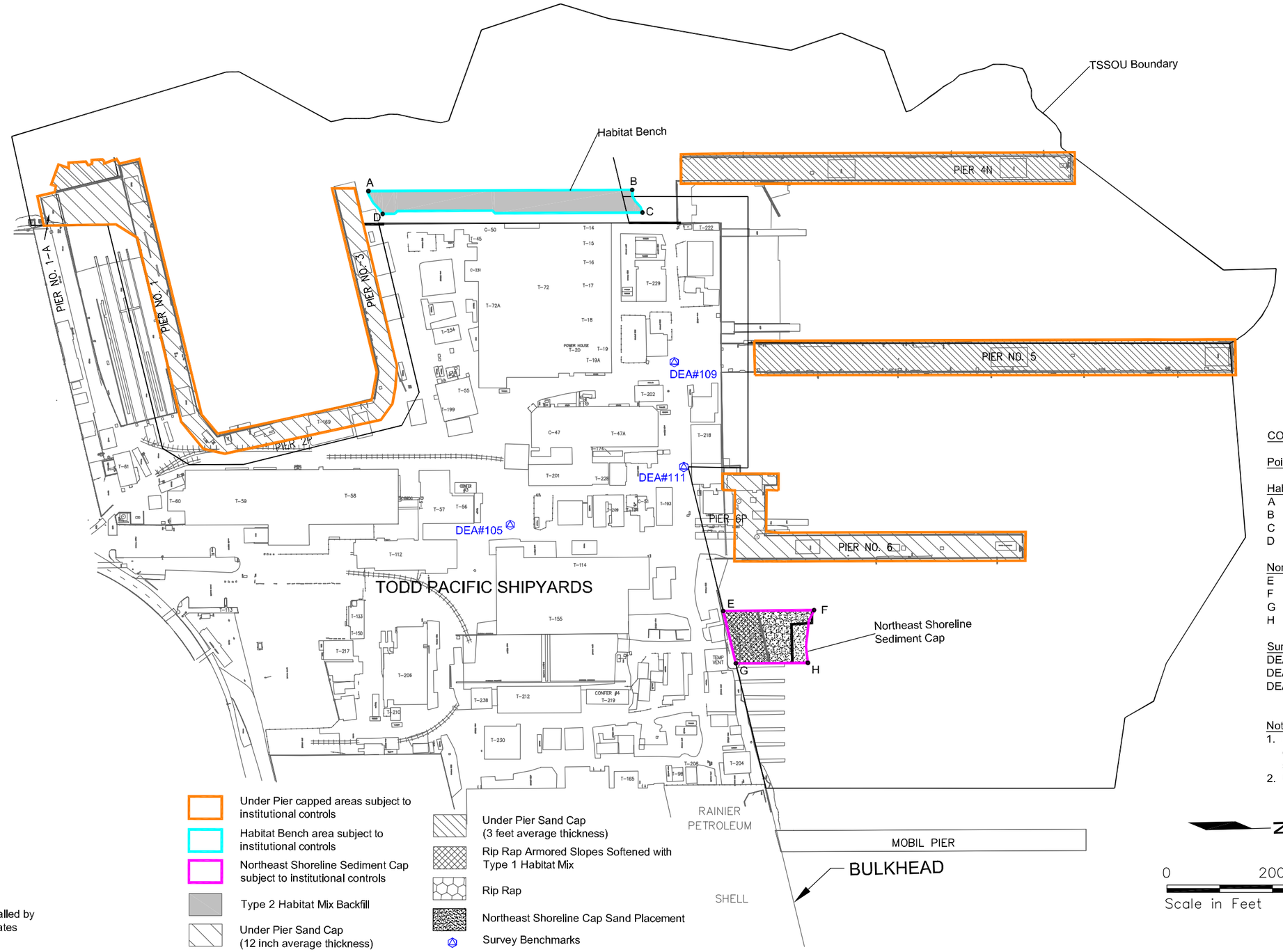
Attachment 1 – Institutional Controls Plan Figure

REFERENCES:

Floyd|Snider. 2007a. *Final Operation, Maintenance, and Monitoring Plan, Todd Shipyards Sediment Operable Unit*. 1 August.

Floyd|Snider. 2007b. *Remedial Action Completion Report, Todd Shipyards Sediment Operable Unit*. 27 July.

LOG OF CHANGES:



Survey Benchmarks installed by David Evans and Associates between 2002 and 2006.

COORDINATES

Point No.	Northing	Easting
Habitat Bench		
A	217125.5	1264140.6
B	217625.4	1264150.9
C	217643.8	1264194.2
D	217151.3	1264184.5
Northeast Shoreline Sediment Cap		
E	217777.5	1264953.5
F	217949.9	1264956.1
G	217798.9	1265053.2
H	217935.8	1265055.6
Survey Benchmarks		
DEA#105	217378.15	1264779.96
DEA#109	217696.71	1264479.48
DEA#111	217709.85	1264678.52

Notes:
1. Limits of under-pier capped areas are defined by extent of existing pier structures.
2. Horizontal Datum: NAD 83.

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KATHRYN H. SNIDER
STATE OF WASHINGTON
29338
REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 3/26/2009

Todd Shipyards
Sediment Operable Unit

Institutional Controls Plan

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Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Appendix F

Todd Process Memorandum: Western Shoreline Habitat Bench Institutional Controls

FINAL

	Document Type: PROCESS MEMORANDUM	Document #:	Revision Date:	
	Document Name: **WESTERN SHORELINE HABITAT BENCH INSTITUTIONAL CONTROLS**		Replaces: N/A	Dated: 10/22/2007
	Process Owner: Secretary & General Counsel	Responsible Managers:		Initials
	Signature			

POLICY:

It is the policy of Todd Pacific Shipyards Corporation to conduct our operations in such a manner as to protect the Western Shoreline Habitat Bench and to monitor and maintain the surface of this habitat bench to ensure that the habitat mix materials remain in place and are not eroded or otherwise disturbed.

SCOPE:

This policy applies to the long-term institutional controls and monitoring and maintenance responsibilities regarding the Western Shoreline Habitat Bench. Additional details regarding the precautions and monitoring and maintenance activities that will be implemented at the habitat bench are included in the Final Operation, Maintenance, and Monitoring Plan (OMMP) for remedial actions performed at the Todd Shipyards Sediment Operable Unit (TSSOU) (Floyd|Snider 2007a).

The habitat bench was designed and constructed to provide juvenile salmon habitat by maximize the area of gently sloping intertidal beach with elevations between +2 and –2 feet mean lower low water (MLLW) (Floyd|Snider 2007b). The habitat bench consists of a minimum 2-foot thickness of sand covered by a 3-foot thickness of Type 2 Habitat Mix. Todd is committed to implementing institutional controls and long-term monitoring and maintenance of the habitat mix on the habitat bench.

RESPONSIBILITY:

The General Counsel shall maintain this policy, as these actions are required by federal consent decree under the Superfund program. This policy can not be modified without legal approval.

DETAIL PROCEDURE:

INSTITUTIONAL CONTROLS

The habitat bench along the western shoreline covers 0.47-acres (refer to Attachment 1). Todd will maintain this area in perpetuity, unless approval is received by USEPA, the Natural Resource agencies, and Todd's General Counsel to cease maintenance.

The shoreline habitat bench is not a CERCLA required element of the project. It was constructed to provide habitat restoration that could be utilized in a future Natural Resource Damage (NRD) Settlement with the NRD Trustees. Todd intends to maintain this area in perpetuity, and to perform long-term periodic monitoring to ensure continued presence of habitat mix materials. Response actions will be implemented if long-term performance standards are not being met. These commitments will be confirmed with the NRD Trustees as part of future settlement negotiations.

PHYSICAL INTEGRITY MONITORING

This section summarizes the schedule and requirements physical integrity monitoring of the habitat bench. Refer to the OMMP for further details on these monitoring events (Floyd|Snider 2007a).

Monitoring Schedule

Baseline and Long-term Routine Monitoring

Visual monitoring surveys by divers along transects at the habitat bench will begin with a baseline survey conducted in 2007 (Year 0) and will be followed by three monitoring surveys during Year 1, Year 2, and Year 4 following completion of the baseline survey. Assuming the baseline survey is completed in the fall of 2007, these monitoring events would occur in the fall of 2008, 2009, and 2011. If habitat mix remains in place after the first three monitoring events, a diver visual survey will be performed again in 5 years, at Year 9 following completion of the baseline survey (scheduled for 2016). If the habitat mix continues to remain in place, long-term monitoring of the habitat bench will be considered complete and no further routine monitoring will be required. However, if monitoring indicates habitat mix is absent from a significant portion of the bench, contingency actions and will be implemented. USEPA can direct a different sequence of monitoring based on changed conditions at the site or EPA can direct Todd to conduct supplementary monitoring to support EPA's five-year reviews.

Supplemental Monitoring

A supplemental visual monitoring survey of the habitat bench will be completed after an earthquake that causes liquefaction of soils or building damage, at or near the site. Occurrence of an earthquake of magnitude 6.0 or greater in western Washington will trigger inquiry by the Port of Seattle and the City of Seattle officials as to whether local liquefaction or building damage occurred. This supplemental survey will occur during a low tide within 60 days of the earthquake or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner and will consist of a visual survey of the habitat bench made from the shoreline. These earthquake supplemental surveys of the habitat mix on the habitat bench will occur throughout the lifetime of the habitat bench.

A supplemental visual monitoring survey of the habitat mix on the habitat bench will also be completed following a severe storm event from a northerly direction that directly exposes the habitat bench to sustained wind and wave action of an extreme magnitude. A 25-year return period wave storm event is considered a severe storm for the habitat bench and this corresponds to a storm where a sustained measured wind speed equals or exceeds 36.7 knots. A storm of this magnitude would likely result in significant loss of the habitat mix from the habitat

bench. To determine if a storm with this wind speed is occurring, the following procedures will be followed:

1. Acquire sustained wind speed (duration longer than 2 minutes) and direction from the National Data Buoy Center at West Point, Washington.

2. Determine maximum sustained wind speeds from the segment of directions 310-030 degrees true north (NW-NNE) for the period of a minimum of 1 hour.

3. Compare wind speeds (those that have direction between 310-030 degrees (NW-NNE)) to the wind speed criterion of 36.7 knots. A storm with a sustained wind speed equal to or greater than 36.7 knots, coming from 310-030 degrees true north, will trigger supplemental monitoring at the habitat bench.

A technical memorandum providing additional details is included as Appendix D of the OMMP. The survey will consist of visual observation of the riprap from the shoreline adjacent to the Northeast Shoreline Sediment Cap during a low tide within 60 days following the severe storm or during a tide which is at or below elevation -2 feet MLLW during daylight hours, whichever is sooner. Supplemental surveys due to severe storms will occur throughout the lifetime of the habitat bench.

Monitoring Methods

It is anticipated that because the grain-size distribution of the Type 2 Habitat Mix was determined based on a site-specific study that it will remain stable despite the erosive wave forces acting on this area of the site.

Physical integrity visual monitoring of the habitat bench will be performed, to determine whether the habitat mix material remains in place over time. This monitoring will consist of a baseline survey and follow-on physical integrity monitoring surveys performed by divers along three transects perpendicular to the shoreline across the habitat bench. Transect locations for the habitat bench are included in the OMMP (refer to OMMP Figure 3.1). Additionally, supplemental visual monitoring surveys of the Habitat Bench may be required due to earthquakes or severe storms.

The Manager of Safety/Quality/Environmental Compliance and the Facilities Manger will coordinate these monitoring events.

Baseline and Long-term Monitoring Surveys

For the baseline and long-term visual monitoring along the habitat bench, divers will observe the substrate conditions along the three transects to verify the presence of habitat mix. An audio/video recording will be produced that documents the conditions of the substrate on the habitat bench during the survey. Detailed diver observations and comments will be made at every 10-foot increment along each transect. If habitat mix is not observed over a portion of one of the transects, additional transects will be surveyed to delineate the extent of the bench where habitat mix material is absent. If habitat mix is absent, contingency actions will be performed.

Supplemental Monitoring Surveys

Supplemental visual monitoring surveys will be conducted on the habitat bench for large earthquakes and severe storms. A supplemental survey will consist of a visual survey of the habitat mix from the shoreline during low tide adjacent to the habitat bench, preferably a tide which is at or below elevation -2 feet MLLW. If an adequate visual survey of the habitat mix from the shoreline cannot be made during low tide, then a visual survey will be conducted by a diver along the three transects using the same procedures described above for the baseline and long-term monitoring surveys. If the habitat mix is noted to be absent in areas of the habitat bench during this visual shoreline survey or the diver transect survey, diver visual transects will then be made to delineate the extent of the habitat mix loss in these areas. Contingency actions will then be implemented.

CONTINGENCY PLANNING AND RESPONSE

In the event that physical integrity monitoring of the Western Shoreline Habitat Bench indicates that complete erosion of the habitat mix is occurring, Todd will implement the contingency process summarized in this section. Further details are included in the OMMP (Floyd|Snider 2007a).

Initial Contingency Screening

The initial contingency screening action will be to delineate the area of concern and extent of erosion by conducting additional diver transects and by comparing the results of the survey to the baseline and previous survey events. The delineation of the extent of the impacted area will occur during the monitoring surveys, described above, if possible. If complete erosion of the habitat mix is observed in any area of the habitat bench, Todd will notify USEPA within 15 days and provide USEPA written documentation within 30 days of receipt of the preliminary field survey observations.

Following notification, Todd will discuss the monitoring results and initial contingency screening results with USEPA to determine whether additional data collection is necessary to further determine the extent of the eroded area. This additional data, if collected, will be forwarded to USEPA within 30 days of receipt.

Evaluating Causes of Erosion

If complete erosion of the habitat mix is observed in a section of the habitat bench, a plan will be put in place to evaluate the cause of this erosion. The possible causes of erosion will be evaluated based on the survey data relative to the baseline survey, any previous monitoring survey events, and available information about local vessel activity or storm events. Patterns of erosion and deposition will be visually analyzed. Identification of the likely cause of the erosion will affect decision making about potential operational controls and material replacement.

If it is determined that the erosion was likely caused by propwash action or other shipyard operations, Todd will determine whether that situation is likely to be repeated, and whether there are operational controls governing propwash or operational best management practices (BMPs) that could be established to control erosion on the habitat bench. Documentation of this evaluation and its resultant recommendation will be provided to the USEPA.

Contingency Action Planning

If habitat mix is observed to be fully eroded in an area exceeding greater than 5,000 contiguous square feet, Todd will submit a Contingency Action Planning Report to USEPA describing plans and contingency response actions to be taken to address this fully eroded area. Todd will submit this report to USEPA within 60 days of the submittal of the Physical Integrity Monitoring Report. The report will include evaluation of the extent and cause of the observed erosion, the proposed replacement plan and any required operational controls to be implemented, and an adjusted monitoring schedule. The need for further sampling and analysis in the habitat bench area will be determined in conjunction with USEPA and if required will be included in the Contingency Action Planning Report.

Based on review of the Contingency Action Planning Report, USEPA and Todd will define, document, and schedule any additional sampling to occur and the contingency response to be performed.

RECORDS:

Draft reports for the baseline and routine long-term physical integrity monitoring surveys will be submitted to USEPA within 45 days after completion of the survey. The actual delivery data may be modified based on approval by USEPA in the event that additional sediment sampling or other contingency response actions become necessary. Final reports will be submitted pending USEPA's review 45 days after receipt and resolution of USEPA comments.

These reports will include an audio/video record documenting the visual observations and real-time comments made during the diver survey. Each report will also include a written evaluation of the data and provide comparisons to previous visual survey observations. Each report will also identify whether contingency actions are warranted in the habitat bench.

Following a severe storm event or earthquake supplemental monitoring inspection, a supplemental monitoring report will be submitted to USEPA within 45 days. Reports will be similar in format and content to the routine physical integrity monitoring reports described above.

Documentation if contingency action is required is described earlier is this document.

ATTACHMENTS:

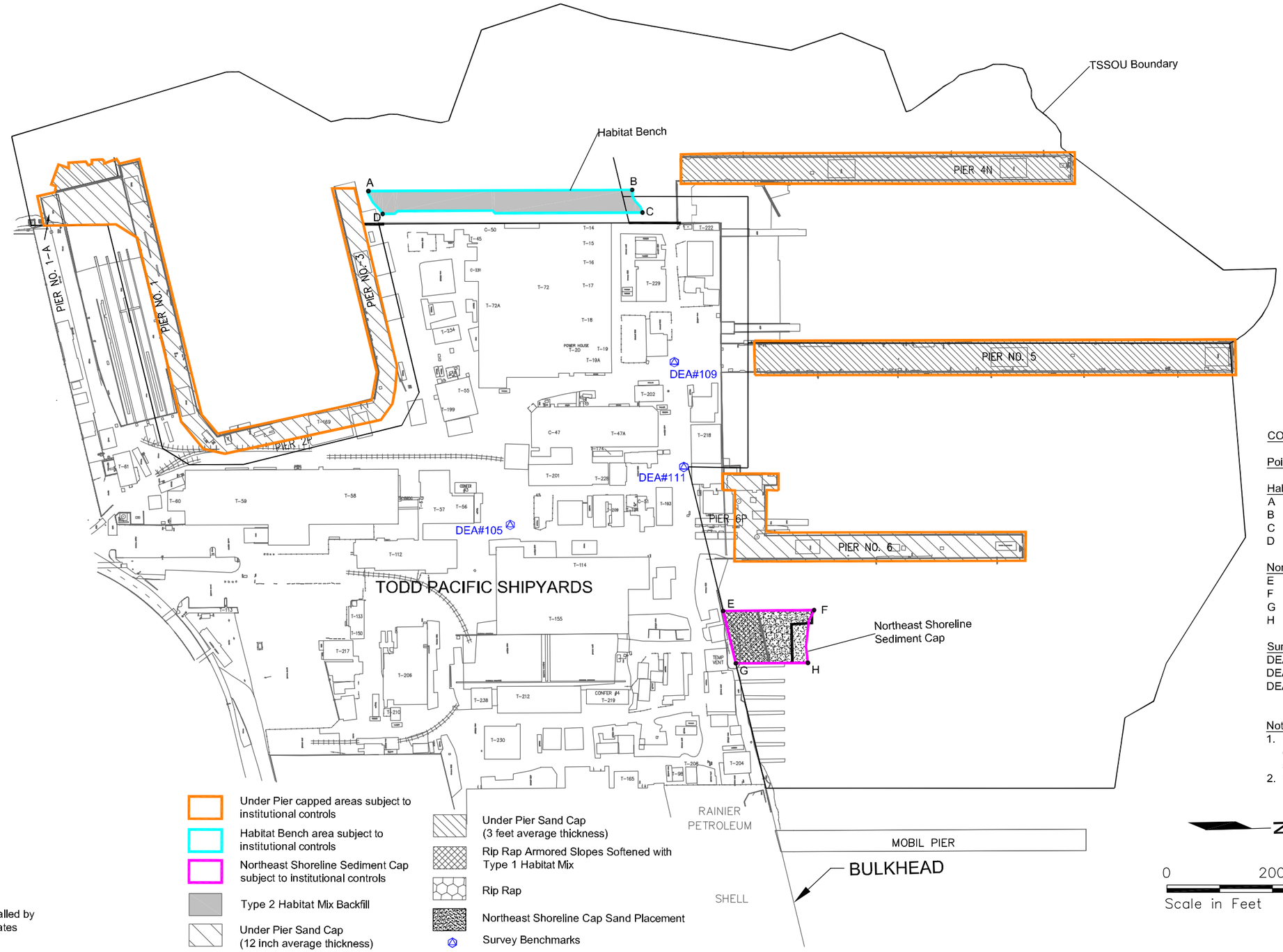
Attachment 1 – Institutional Controls Plan Figure

REFERENCES:

Floyd|Snider. 2007a. *Final Operation, Maintenance, and Monitoring Plan, Todd Shipyards Sediment Operable Unit*. 1 August.

Floyd|Snider. 2007b *Remedial Action Completion Report, Todd Shipyards Sediment Operable Unit*. 27 July.

LOG OF CHANGES:



Survey Benchmarks installed by David Evans and Associates between 2002 and 2006.

COORDINATES

Point No.	Northing	Easting
Habitat Bench		
A	217125.5	1264140.6
B	217625.4	1264150.9
C	217643.8	1264194.2
D	217151.3	1264184.5
Northeast Shoreline Sediment Cap		
E	217777.5	1264953.5
F	217949.9	1264956.1
G	217798.9	1265053.2
H	217935.8	1265055.6
Survey Benchmarks		
DEA#105	217378.15	1264779.96
DEA#109	217696.71	1264479.48
DEA#111	217709.85	1264678.52

Notes:
1. Limits of under-pier capped areas are defined by extent of existing pier structures.
2. Horizontal Datum: NAD 83.

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Todd Shipyards
Sediment Operable Unit

Institutional Controls Plan

DWG NAME: G:\project\clients\Floyd and Snider\todd\technical\todd0165.dwg
DATE: 07/31/07 3:54pm

Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Appendix G
Todd Process Memorandum: Under-pier Sediment Caps Institutional Controls

FINAL

	Document Type: PROCESS MEMORANDUM	Document #:	Revision Date:	
	Document Name: **UNDER-PIER CAPS INSTITUTIONAL CONTROLS**		Replaces: N/A	Dated: 10/22/2007
Process Owner: Secretary & General Counsel		Responsible Managers:		Initials
Signature				

POLICY:

It is the policy of Todd Pacific Shipyards Corporation to conduct our operations in such a manner as to protect the under-pier sediment cap areas and to monitor and maintain these caps to ensure that the sand caps remain in place and are not eroded or otherwise disturbed.

SCOPE:

This policy applies to the institutional controls and monitoring and maintenance responsibilities regarding the under-pier sediment caps. Additional details regarding the precautions and monitoring and maintenance activities that will be implemented at the under-pier sand cap areas are included in the Final Operation, Maintenance, and Monitoring Plan (OMMP) for remedial actions performed at the Todd Shipyards Sediment Operable Unit (TSSOU) (Floyd|Snider 2007a).

The under-pier capped area were designed and constructed to provide new substrate for biological re-colonization and to reduce overall toxicological exposure to biological receptors by reducing their physical contact with chemicals of concern (COCs) in the underlying sediment (Floyd|Snider 2007b). The under-pier cap layer is not expected to provide chemical containment. An average 1-foot thick sand cap was placed under Piers 1A, 1, 2P, 3, 6, and 6P and within the over-water areas of the building berth and an average 3-feet thick sand cap was placed under Piers 4N and 5. Todd will monitor and maintain the sand caps in these under-pier areas over the lifetime of the piers.

RESPONSIBILITY:

The General Counsel shall maintain this policy, as these actions are required by federal consent decree under the Superfund program. This policy can not be modified without legal approval.

DETAIL PROCEDURE:

INSTITUTIONAL CONTROLS

Under-pier capped areas include Piers 1A, 1, 2P, 3, 4N, 5, 6, and 6P and within the over-water areas of the building berth (refer to Attachment 1). While the piers are in use, long-term physical integrity monitoring surveys will occur beneath the piers to ensure the caps remain in place and contingency actions will be implemented in the event that there is evidence of

significant cap erosion (see below). In addition, Todd will not excavate or dredge within this area without USEPA approval and appropriate planning.

To prevent or minimize erosion of the under-pier caps, best management practices (BMPs) will be implemented for Propeller and Rudder Turning (refer to Process Memorandum 12.1.33), which requires ships operating adjacent to the piers to restrict engine power to minimum levels and for tugs not to operate such that prop wash is directed toward the caps.

When the existing pier structures reach the end of their serviceable capacity and are demolished, under-pier sediment will be dredged for permanent cleanup. A pier structure is determined to be at the end of its serviceable capacity when it is condemned for use by heavy industrial vehicular traffic, such as fire truck access. When a pier is condemned, demolition and cleanup will begin within one year following condemnation and will be completed within three years following condemnation. After permanent cleanup has been completed in an under-pier area, under-pier monitoring or maintenance in that area is no longer required.

PHYSICAL INTEGRITY MONITORING

This section summarizes the schedule and requirements physical integrity monitoring of the under-pier capped areas. Refer to the OMMP for further details on these monitoring events (Floyd|Snider 2007a).

Monitoring Schedule

Baseline and Long-term Routine Monitoring

Visual monitoring surveys by divers along transects at the under-pier capped areas will begin with a baseline survey conducted in 2007 (Year 0) and will be followed by three monitoring surveys during Year 1, Year 2, and Year 4 following completion of the baseline survey. Assuming the baseline survey is completed in the fall of 2007, these monitoring events would occur in the fall of 2008, 2009, and 2011. If the sand cap remains in place after the first three monitoring events, a diver visual survey will be performed again in 5 years, at Year 9 following completion of the baseline survey (scheduled for 2016). If the sand cap continues to remain in place, long-term monitoring of the under-pier capped areas will be considered complete and no further routine monitoring will be required. However, if monitoring indicates that significant erosion of the under-pier cap has occurred, contingency actions a will be implemented. USEPA can direct a different sequence of monitoring based on changed conditions at the site or EPA can direct Todd to conduct supplementary monitoring to support EPA's five-year reviews. Some under-pier capped areas may need to be monitored more frequently than others depending on the results of the routine monitoring.

Supplemental Monitoring

An under-pier cap supplemental visual monitoring survey will be completed by divers within 60 days after an earthquake that causes liquefaction of soils or building damage, at or near the site. Occurrence of an earthquake of magnitude 6.0 or greater in western Washington will trigger inquiry by the Port of Seattle and the City of Seattle officials as to whether local liquefaction or building damage occurred. Under-pier surveys triggered by earthquakes will occur until all the piers have been demolished and contaminated sediments beneath them removed.

Monitoring Methods

Under-pier cap monitoring for Piers 1A, 1, 2P, 3, 4N, 5, 6, and 6P and within the over-water areas of the building berth will be performed using diver surveys along specified transects. This monitoring will consist of a baseline visual survey and follow-on long-term monitoring visual surveys. Additionally, supplemental visual monitoring surveys of the caps may be required due to earthquakes.

The Manager of Safety/Quality/Environmental Compliance and the Facilities Manger will coordinate these monitoring events.

Transect Locations

Under-pier cap monitoring will take place along 17 transects, which are specified in the OMMP (refer to OMMP Figure 3.1). The number and location of transects were selected to provide a systematic and spatially diverse representation of under-pier conditions throughout the shipyard.

Baseline Survey

A baseline diver survey will be conducted to visually document initial coverage of the under-pier sand cap areas. In preparation for the baseline survey the diver will place a flexible fiberglass measuring tape along each pre-selected transect. The diver will then swim the transect line carefully, continuously observing the substrate type and coverage. An underwater audio/video recording will be produced documenting the diver's observations and real-time comments along each transect. Detailed diver observations and comments will be made at 10-foot increment along each transect, and will include a determination of whether the substrate is sand cap material (coarse- to medium-grained sand), recently deposited sediment overlying the cap, or sediment that was previously capped but uncovered due to erosion or downslope movement of the cap material. If the cap material is covered with recent sediment deposits, the diver will use a sampling spoon to uncover and document the presence of cap material. Two surface samples of the in-place cap material will be collected from each transect using 10 cm diver cores. These samples will be tested to determine the grain-size distribution of the cap material for future comparison with long-term monitoring survey results, as discussed below. Survey and sampling methods will be performed very carefully so as to minimize disturbance of the cap.

Long-term Monitoring Surveys

Physical integrity visual monitoring will be conducted by diver surveys, performed over time, to assess and document coverage of the under-pier cap areas. Diver surveys will be performed along the 17 transects using the same techniques discussed for the baseline survey. If the diver is unable to visually determine and document the substrate type at any of the 10-foot monitoring stations along the transects, a surface sample will be collected and a grain-size analysis performed to determine whether or not the material is similar to the sand used for capping (as demonstrated by a comparison to the grain-size distribution of cap materials performed during the baseline survey). If diver survey results reveal erosion of capped areas that expose underlying sediments, contingency actions will be performed to address the eroded area.

Supplemental Monitoring Surveys

Supplemental visual monitoring surveys will be conducted for the under-pier cap areas in the event of an earthquake that causes liquefaction of soils or building damage, at or near the site. Diver surveys will be performed along the same transects and the same techniques discussed above for these long-term monitoring surveys. If the sand cap is noted to be absent in an under-pier area during these visual diver surveys, additional transects will be surveyed to delineate the extent of the loss in the areas where erosion of the cap is observed. Contingency actions will then be implemented.

CONTINGENCY PLANNING AND RESPONSE

In the event that physical integrity monitoring of the under-pier capped areas indicates that complete erosion of the sand cap has occurred, Todd will implement the contingency process summarized in this section. Further details are included in the OMMP (Floyd|Snider 2007a).

Initial Contingency Screening

The initial contingency screening action will be to delineate the area of concern and extent of erosion by conducting additional diver transects and by comparing the results of the survey to the baseline and previous survey events. The delineation of the extent of the impacted area will occur during the monitoring surveys, described above, if possible. If complete erosion of the sand cap is observed in any under-pier area, Todd will notify USEPA within 15 days and provide USEPA written documentation within 30 days of receipt of the preliminary field survey observations.

Following notification, Todd will discuss the monitoring results and initial contingency screening results with USEPA to determine whether additional data collection is necessary to further determine the extent of the eroded area. Additional delineation could include additional diver transects of the area. Additional sediment samples may also be collected for grain-size analysis for comparison to baseline samples. This additional data, if collected, will be forwarded to USEPA within 30 days of receipt.

Evaluating Causes of Erosion

If complete erosion of the sand cap is observed in an under-pier area, a plan will be put in place to evaluate the cause of this erosion. The possible causes of erosion will be evaluated based on the survey data relative to the baseline survey, any previous monitoring survey events, and available information about local vessel activity or storm events. Patterns of erosion and deposition will be visually analyzed. Identification of the likely cause of the erosion will affect decision making about potential operational controls and material replacement.

If it is determined that the erosion was likely caused by propwash action or other shipyard operations, Todd will determine whether that situation is likely to be repeated, and whether there are operational controls governing propwash or operational best management practices (BMPs) that could be established to control erosion in the under-pier areas. Documentation of this evaluation and its resultant recommendation will be provided to the USEPA.

Contingency Action Planning

If the under-pier sand cap is observed to be fully eroded over an area exceeding greater than 5,000 contiguous square feet, Todd will submit a Contingency Action Planning Report to USEPA describing plans and contingency response actions to be taken to address this fully eroded area. Todd will submit this report to USEPA within 60 days of the submittal of the Physical Integrity Monitoring Report. The report will include evaluation of the extent and cause of the observed erosion, the proposed replacement plan and any required operational controls to be implemented, and an adjusted monitoring schedule.

Todd may also conduct additional sediment evaluations and sampling in the under-pier areas or in open-water areas adjacent to the piers, as discussed below. The Contingency Action Planning Report will include these sampling results and associated mapping, if this sampling is conducted prior to reporting.

Based on review of the Contingency Action Planning Report, USEPA and Todd will define, document, and schedule any additional sampling to occur and the contingency response to be performed.

Chemical Sampling of Under-pier Area Underlying Sediments

If complete erosion of the sand cap material over a contiguous 5,000-square-foot area is observed in an under-pier area, Todd may collect surface samples of the underlying sediment. These underlying sediment sampled would be analyzed for all COCs in accordance with the procedure and frequency requirements described in the OMMP Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) (refer to OMMP Appendix I).

If the underlying sediment does not exceed the cleanup criteria (refer to OMMP Table 1.1), material replacement is not required, and chemical sampling of adjacent open-water areas, described below, will not be performed. If underlying sediments are determined to contain COCs at concentrations above the cleanup criteria, then cap material will be replaced, to the extent feasible, to the average cap thicknesses specified in the remedial action design, and chemical sampling of adjacent open-water areas will be performed.

Chemical Sampling of Open-water Area Sediments Adjacent to the Under-pier Areas

If complete erosion of the sand cap material is identified over a contiguous 5,000-square-foot area and contamination exceeding the cleanup criteria is also identified in the exposed under-pier sediments, chemical sampling of adjacent open-water areas will be required. Sampling will be performed to determine whether erosion of under-pier sediments has caused recontamination of the adjacent open-water areas.

If sampling of open-water areas is determined to be necessary, Todd will prepare a map of proposed sediment sampling locations to include in the Contingency Action Planning Report, and will obtain USEPA's approval prior to collecting sediment samples. The sampling locations will be representative of the open-water bathymetry immediately adjacent to the area of complete erosion of under-pier cap material. Samples will be collected and analyzed in accordance with the procedure and frequency requirements described in OMMP SAP and QAPP or in accordance with procedures acceptable to USEPA.

If, through the procedures defined above, it is determined that erosion of under-pier sediments has caused recontamination of adjacent open-water areas at levels of concern, contingency actions for remediation of the open-water areas will be proposed and negotiated with USEPA.

RECORDS:

Draft reports for the baseline and routine long-term physical integrity monitoring surveys will be submitted to USEPA within 45 days after completion of the survey. The actual delivery data may be modified based on approval by USEPA in the event that additional sediment sampling or other contingency response actions become necessary. Final reports will be submitted pending USEPA's review 45 days after receipt and resolution of USEPA comments.

These reports will include an audio/video record documenting the visual observations and real-time comments made during the diver survey. For sediment samples collected for grain-size analysis along the transects, a summary of field sampling activities and the samples collected will be included in the report, along with field sampling logs, a figure showing sample locations, tabulated grain-size analysis results, and the laboratory analysis reports. Each report will also include a written evaluation of the data and provide comparisons to previous visual survey observations and grain-size analysis results. Each report will also identify whether contingency actions are warranted in the under-pier capped areas.

Following an earthquake supplemental monitoring inspection, a supplemental monitoring report will be submitted to USEPA within 45 days. Reports will be similar in format and content to the routine physical integrity monitoring reports described above.

Documentation if contingency action is required is described earlier is this document.

ATTACHMENTS:

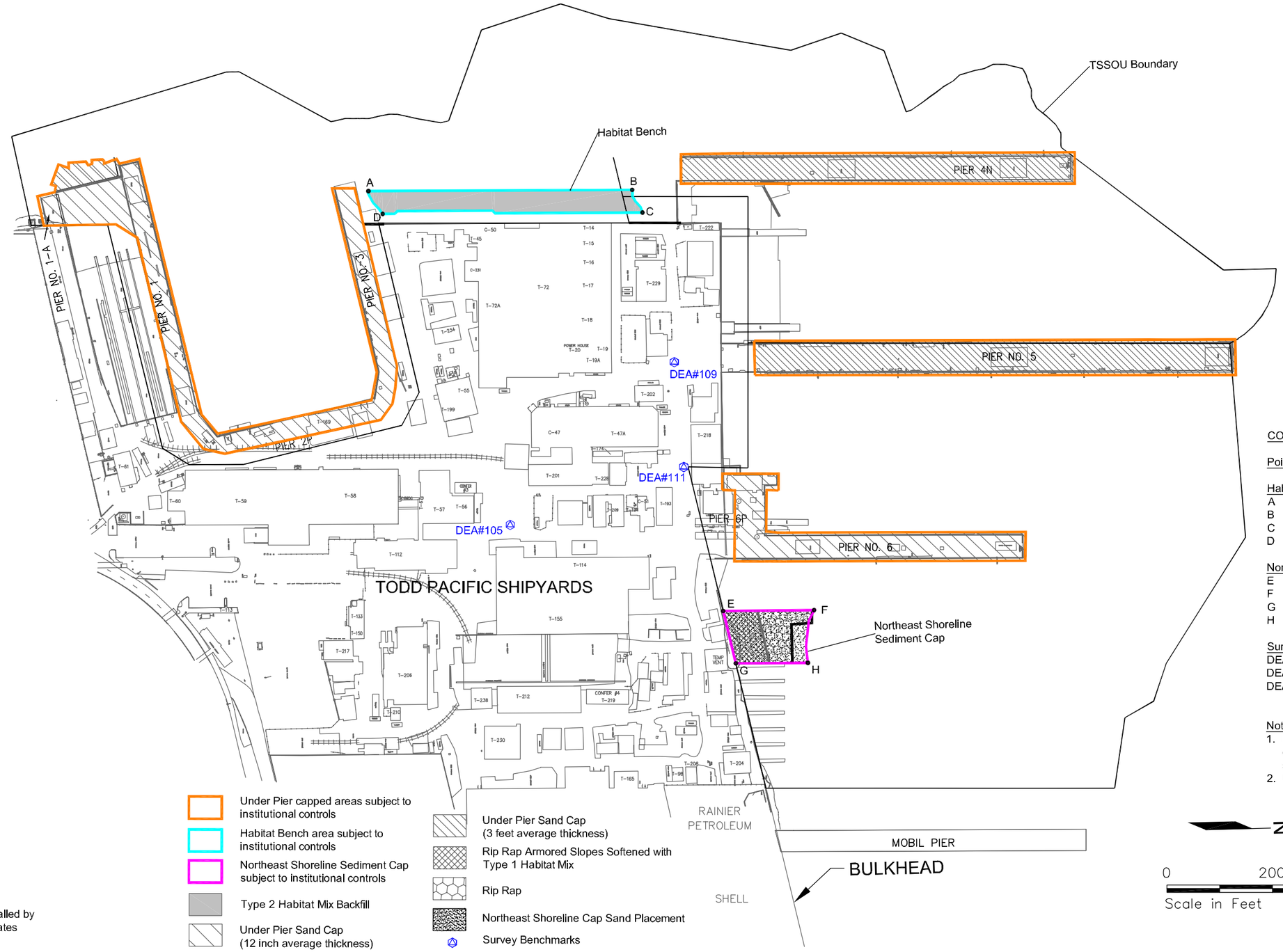
Attachment 1 – Institutional Controls Plan Figure

REFERENCES:

Floyd|Snider. 2007a. *Final Operation, Maintenance, and Monitoring Plan, Todd Shipyards Sediment Operable Unit*. 1 August.

Floyd|Snider. 2007b *Remedial Action Completion Report, Todd Shipyards Sediment Operable Unit*. 27 July.

LOG OF CHANGES:



Survey Benchmarks installed by David Evans and Associates between 2002 and 2006.

COORDINATES

Point No.	Northing	Easting
Habitat Bench		
A	217125.5	1264140.6
B	217625.4	1264150.9
C	217643.8	1264194.2
D	217151.3	1264184.5
Northeast Shoreline Sediment Cap		
E	217777.5	1264953.5
F	217949.9	1264956.1
G	217798.9	1265053.2
H	217935.8	1265055.6
Survey Benchmarks		
DEA#105	217378.15	1264779.96
DEA#109	217696.71	1264479.48
DEA#111	217709.85	1264678.52

Notes:
1. Limits of under-pier capped areas are defined by extent of existing pier structures.
2. Horizontal Datum: NAD 83.

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EXPIRES: 3/26/2009

Todd Shipyards
Sediment Operable Unit

Institutional Controls Plan

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DATE: 07/31/07 3:54pm

Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Appendix H
Todd Process Memorandum: Propeller and Rudder Turning

FINAL

RECEIVED
JUN 28 2007
BY:

Document Type: PROCESS MEMORANDUM	Document #: 12.1.33	Revision Date: 03/03/2005
		Revision Level: A
Document Name: **PROPELLER AND RUDDER TURNING**		Replaces: POLICY 12.1.33 / Dated: 01/08/2003
Process Owner: MANAGER OF SAFETY/QUALITY/ENVIRONMENTAL COMPLIANCE	Responsible Managers: PRODUCTION MANAGER(S) – VESSELS - SEATTLE CMT PROGRAM MANAGER DIRECTOR OF SHIP REPAIR PROGRAMS FACILITIES MANAGER	

POLICY:

It is the policy of Todd Pacific Shipyards Corporation to conduct our operations in such a manner as to protect the sea bed adjacent to our piers and docks in accordance with applicable laws, regulations and best practices.

SCOPE:

This policy applies to the precautions and responsibilities regarding the turning of a vessel's propeller or rudder in dry dock or afloat.

RESPONSIBILITY:

The Manager of S/Q/E Compliance shall maintain this policy.

DETAIL PROCEDURE:

PROPELLOR TURNING WHEN PIERSIDE/AFLOAT

All vessels entering and exiting the Todd Seattle facility (including tugs associated with customer vessels) shall be requested, by the Production Supervisor overseeing rigging and mooring operations, to reduce propeller revolution to the minimum to accomplish navigation. The purpose of this requirement is to maintain the integrity of the under pier sand caps.

Sustained propeller thrust (Dock Trials or any other operation beyond normal maneuvering for mooring or departure) is permitted only at deep-water piers 4 north and 5 north. Alternatively, Dock Trials may be accomplished utilizing tug assistance away from the piers. Tide conditions shall also be taken into consideration when scheduling dock trials. High tides provide additional depth and are preferred. The Production Supervisor shall research tide schedules prior to scheduling and planning trials. A TS-133 shall be completed as record of dock trials.

Rudder swings for the purpose of testing rudder systems (with no concurrent propeller rotation) generate minimal turbulence and are subject to normal safety precautions. Rudder swings **during** propeller rotation **must** be limited to only the amount necessary to adjust vessel thrust direction for mooring security. High angles and repeated cycles must be

prohibited to avoid putting undue strain on mooring lines and sea bottom disturbance under the piers.

The Facilities Manager shall coordinate periodic visual diving inspections to evaluate the condition of the sand caps and to detect emerging changes to the slope, depth or character of the sea bed both under and adjacent to our piers.

The Manager of Safety/Quality/Environmental Compliance will coordinate long term monitoring that is required by the Environmental Protection Agency.

Dockside trials of double-ended vessels (such as ferries) that will involve power levels above normal maneuvering power, or are sustained for a time greater than needed for normal vessel arrival or departure operations, are prohibited unless approval is granted by the President of the company. Dock Trials by vessels using Voith-Schneider or similar vertical propeller systems are also prohibited unless approval is granted by the President. Rudder swings during dock trials are also prohibited.

PROPELLOR TURNING IN DRY DOCK

When a vessel is in dry dock and it becomes necessary to turn the propeller, the Production Supervisor shall notify the Manager of S/Q/E Compliance, due to environmental concerns, prior to the operation. It shall be the responsibility of the Production Supervisor to see that a person with a yard radio is stationed both on the dry dock floor in full view of the propeller and inside at the ship's jacking gear. The vessel's officers shall not turn the vessel's propeller without the specific knowledge and consent of the Ship Manager.

Before the propeller or rudder is rotated, good radio or sound powered phone communication shall be established between the person on the dry dock floor and the person inside. It may be best to use a channel different than the main yard channel so there is no interference with the communication. The yard employee that is stationed inside the vessel is under no circumstance to operate the vessel's jacking gear. Only the ship's crew is allowed to perform this operation. After the person stationed outside the vessel has established radio communication, and has checked that the propeller is clear to turn, the rotation of the propeller can start. Inside and outside monitoring shall be maintained until rotation has stopped and operating gear is secured by ship's crew.

RECORDS:

Record	**Location**	**Duration**
Dock Trials form (TS-133)	Facilities	Cumulative

All Dock Trials require records be kept by the Project Manager identifying the following:

- Date of trial conducted
- Type of trial conducted
- Duration of trial conducted
- Location of trial conducted
- Any engineering calculations of trial conducted

ATTACHMENTS:

Attachment 1 – Dockside Power Trial Data

LOG OF CHANGES:

Date	Revision Level	Changes	Reason
03/03/2005	A	▪ Titles updated ▪ Information given on prop turning when afloat ▪ Station two persons w/radios, one on dd, one inside vessel ▪ Ensure good communication is established ▪ Only ship's crew may operate jacking gear ▪ All dock trials must be documented and the record maintained in Facilities on TS 133 ▪ Attachment 1 added	Document Review and Company Reorganization

Operation, Maintenance, and Monitoring Plan

Todd Shipyards
Sediment Operable Unit

Appendix I
Sampling and Analysis Plan and Quality Assurance Project Plan

FINAL

Sampling and Analysis Plan
and
Quality Assurance Project Plan

Todd Shipyards
Sediment Operable Unit

Prepared for

Todd Pacific Shipyards Corporation

Prepared by

FLOYD | SNIDER

August 1, 2007

FINAL

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1.0 Introduction

Long-term maintenance and monitoring activities will be conducted at the Todd Shipyards Sediment Operable Unit (TSSOU), Harbor Island Superfund Site, in Seattle, Washington to assure long-term effectiveness of the constructed remedy. This document presents the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) for baseline and long-term physical integrity monitoring at TSSOU. This SAP and QAPP also applies to sample collection that may occur for contingency action planning, if these actions are triggered and additional sampling is required. This document was developed in accordance with the Remedial Action Consent Decree (CD; USEPA 2003a) and Statement of Work (SOW) for Remedial Action and Long-term Monitoring (USEPA 2003b).

2.0 Purpose

The SAP and QAPP defines the sampling and analysis procedures that will be followed for diver sediment surface sampling during physical integrity monitoring surveys or during contingency planning activities as part of the operation, maintenance, and monitoring activities for the TSSOU. In addition, this document also specifies the quality assurance (QA) procedures that will be followed during sampling and analysis activities. The SAP and QAPP specifies the following procedures to be followed during baseline and long-term monitoring surveys or contingency planning activities:

- Sampling, testing, and monitoring to be conducted
- Data quality objectives (DQOs), including details of field sampling and laboratory analyses, QA tests, and laboratory procedures
- QA procedures during sampling and analysis
- Final documentation requirements for sampling and analysis

The SAP and QAPP was developed to support the long-term monitoring objective to verify the continued long-term effectiveness of the remedy in protecting human health and the environment, in accordance with the SOW for remedial action and long-term monitoring.

3.0 Project Participants and Responsibilities

The following sections describe the roles and responsibilities for project participants.

3.1 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

The USEPA is responsible for overall coordination and decision-making for the sediment remediation activities, as well as coordinating, as necessary, with other agencies and authorities. The USEPA is responsible for reviewing and approving the Operations, Maintenance, and Monitoring Plan (OMMP) and associated documentation to ensure the project QA program is consistent with the remedial design objective. USEPA will be responsible for overseeing the baseline and long-term monitoring activities, reviewing baseline and long-term monitoring documentation, and approving contingency actions if necessary.

3.2 TODD PACIFIC SHIPYARDS

Todd Pacific Shipyards' (Todd's) responsibilities include project direction and oversight, space allocation, site access, and other miscellaneous support items associated with the planning and performance of the work.

3.3 FLOYD|SNIDER, INC.

Floyd|Snider, Inc. (Floyd|Snider) is under contract to Todd and is responsible for long-term monitoring and maintenance planning and management, including selecting and supervising sample collection subcontractors and laboratories. Sampling and laboratory analysis will be performed under subcontract to Floyd|Snider. The responsibilities of Floyd|Snider include:

- Provide field personnel to manage and aid in field activities, including sampling and monitoring activities, chain-of-custody records, and proper transport and handling of samples to analytical or physical sampling laboratory. Field personnel will document field work and handle sample processing.
- Ensure baseline and long-term monitoring surface sediment sampling is performed at the required times according to the OMMP and that sediment sampling for contingency action planning is performed, if necessary.
- Obtain authorization to work at the site.
- Perform data validation of all sediment sample results, including reporting and laboratory analysis procedures.
- Ensure compliance with SAP and QAPP by all project participants.

3.4 ANALYTICAL DATA REVIEWER

Sediment analysis for chemicals of concern (COCs) may occur as part of contingency action planning, but is not included as part of the routine long-term monitoring activities. A Floyd|Snider analytical data reviewer will be responsible for reviewing all analytical laboratory sediment data collected as part of the contingency action planning to ensure that DQOs are met. A data

validation report will be prepared for data validation activities, as described in the appropriate sections of the USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review (USEPA 1999; 2004) and the Data Validation Guidance Manual for Selected Sediment Variables (PTI 1989).

3.5 SEDIMENT SUBCONTRACTOR

Research Support Services (RSS) will perform visual observations of the surfaces of the under-pier capped areas, the Northeast Shoreline Sediment Cap, and the Western Shoreline Habitat Bench and will collect surface sediment sampling of the under-pier capped areas during the baseline and long-term physical integrity monitoring events. RSS will also perform supplemental monitoring surveys following earthquakes, and possibly severe storms. If a contingency response action is triggered, RSS will also conduct additional delineation of the eroded area and additional sediment sampling as required based on discussions between Todd and USEPA.

RSS will mobilize and demobilize the required vessel and sampling equipment and supplies to and from the site. In addition, RSS will be responsible for arriving at the site with clean equipment and for decontaminating all equipment between sample locations. In summary, RSS will be responsible for the following:

- Provide and operate the support vessels and diving equipment required to complete the work
- Provide divers to conduct the visual surveys and collect sediment samples
- Provide field personnel to document field work
- Provide clean decontaminated sampling equipment
- Provide decontamination equipment for cleaning sampling gear between sample locations and before leaving the site
- Follow chain-of-custody procedures
- Provide navigation equipment (differential global positioning system [DGPS])
- Provide personal protective equipment for crew
- Provide spill prevention and cleanup equipment (for sampling activities only)
- Document compliance with health and safety requirements

3.6 ANALYTICAL AND PHYSICAL TESTING LABORATORY

Analytical Resources, Inc., (ARI) in Tukwila, Washington will conduct grain size analyses for sediment samples collected during the physical integrity baseline and routine long-term monitoring events. If applicable, ARI will also conduct all chemical testing of sediment for contingency action planning. ARI will be responsible for calculating method detection limits for each COC. The detection limits will be less than the criteria for sediment quality.

ARI will be responsible for adhering to the methods specified in the QAPP (including DQOs), reporting requirements for deliverables, providing electronic and hard copies of deliverables, and meeting turnaround times. ARI will contact the Project Manager and/or the Floyd|Snider QA Officer immediately if any data quality control limits are exceeded. ARI will employ a QA

Officer to ensure all quality control indicators are within contract specifications. ARI's QA Officer will implement necessary action and adjustments to accomplish analytical project objectives.

4.0 Physical Integrity Monitoring and Sediment Sampling

The constructed elements of the remedial action that are subject to long-term physical integrity monitoring include:

- The under-pier capped areas
- The permanent Northeast Shoreline Sediment Cap
- The Western Shoreline Habitat Bench

Long-term physical integrity monitoring of the surfaces of these three elements will be conducted to evaluate if the integrity of the constructed surfaces is maintained and is not changing significantly over time. The monitored surfaces include the sand caps placed in the under-pier capped areas, riprap on the sediment cap, and habitat mix on the habitat bench. Visual observations of these surfaces will be made by divers along selected transects. Sediment samples will also be collected by the divers from the under-pier sediment caps during the baseline monitoring event, and potentially during long-term or supplemental monitoring events, to determine the grain size distribution of the cap material. Long-term or supplemental survey grain size sediment sample results will be compared to the baseline grain size analysis results. Additional sediment sampling for COC analysis in the under-pier areas or in the open water areas adjacent to the under-pier areas may also occur as part of contingency action planning.

The visual monitoring survey procedures and the sampling and analytical procedures for surface sediment sampling are discussed in the following sections. The sediment sampling and analytical procedures described below cover both monitoring and contingency action planning, and include a description of field sampling equipment, sediment sampling locations, sediment sampling and processing procedures, and sediment analytical methods.

4.1 VISUAL MONITORING SURVEY BY DIVERS

4.1.1 Diving Equipment and General Procedures

Diving operations for visual monitoring will be conducted from a 24-foot aluminum work boat with an A-frame, or a comparable boat, to accommodate all equipment and personnel required for the work. A dive ladder will be deployed over the side of the boat for diving operations and dive flags will be flown from the A-frame. Safety equipment on the boat will include personal floatation devices (PFDs), a first aid kit, fire extinguisher, and emergency oxygen.

Diver transects for physical integrity monitoring are shown on OMMP Figure 3.1. Diver positioning on the transect will be accomplished using existing structures and/or a Trimble Pathfinder TSC-1 datalogger and Trimble Pro-XRS DGPS receiver, or equivalent, which is capable of submeter accuracy. Coordinates for each transect will be predetermined by Floyd|Snider; however, if changes are made to those positions in the field for any reason, the actual location of the transect terminus will be recorded on the GPS and a data sheet by the field crew.

Divers will be in voice communication with each other and the surface at all times via single sideband wireless communicators. In the event of a communication failure, there will be an evaluation of the surface conditions and underwater visibility to determine if conditions allow diving operations to continue.

Underwater video footage will be collected using a Song VX2100 3CCD digital mini DV camcorder, or equivalent, in an underwater housing. The camera is capable of extreme close ups for confirming the presence of cap material. The housing will be equipped with lights and diver communications are hardwired to the camera housing, enabling all diver and surface communications to be directly recorded. A video uplink cable and surface monitor will be used to allow the surface team to monitor and, if necessary, direct the underwater activities.

4.1.1.1 Pre-Dive Procedures

Procedures that will be implemented prior to diving operations at TSSOU include the following:

- The U.S. Coast Guard in Seattle will be provided with an e-mailed copy of the Dive Plan (e-mail the Dive Plan to hlswatch@pacnorwest.uscg.mil)
- The Coast Guard Marine Safety Unit will be notified on the day of work prior to commencing the diving operation and then again when work is finished for the day at (206) 217-6002.
- A pre-dive briefing will be conducted to familiarize divers and surface personnel of site-specific hazards and to ensure readiness to work.

4.1.1.2 Diving Safety Procedures

Diving safety procedures that will be implemented during diving operations at TSSOU include the following:

- Diving operations will be conducted in accordance with federal and state health and safety regulations. The Floyd|Snider site-specific Health and Safety Plan and the RSS Dive Safety Plan will apply to the operation and will be reviewed by all participants.
- The Coast Guard will be notified of the operation (refer to Section 4.1.1.1). No special vessel consideration, such as a no wake zone, is expected to be needed.
- The support vessel will be anchored near the divers' location. A red-and-white diver flag and blue-and-white alpha flag will be flown conspicuously when a diver is in the water.
- Two divers will enter the water together and support each other as a buddy team.
- Contamination precautions will include a drysuit with attached latex hood and gloves and positive pressure full-face mask.
- Emergency oxygen will be available on-site in case of a pressure-related injury. In addition to administration of oxygen to an injured diver, basic first aid and activation of emergency medical services will apply.

4.1.2 Diver Visual Monitoring Survey

In preparation for the baseline survey the diver will place a flexible fiberglass measuring tape along each pre-selected transect. For the under-pier areas, the 0–foot line on the tape will be placed 10 feet waterward of the face of the pier and the tape will extend underneath the pier either to the point near the top of the slope (~0 feet Mean Lower Low Water [MLLW]) where cap material was not placed and riprap is exposed (at Piers 1A, 1, 2P, and 3) or to a point 10 feet past the opposite pier face (at Piers 4N, 5, and 6).

The divers will then swim each transect line carefully, continuously observing the substrate type and coverage. An underwater audio/video recording will be produced documenting the diver's observations and real-time comments along each transect. Detailed diver observations and comments will be made at 10-foot increments along each transect. For the under-pier capped areas, the divers will determine whether the substrate is sand cap material (coarse- to medium-grained sand), recently deposited sediment overlying the cap, or sediment that was previously capped but uncovered due to erosion or downslope movement of the cap material. If the sand cap material is covered with recent sediment deposits, the diver will use a sampling spoon to uncover and document the presence of cap material. Using a similar method, the divers will determine whether the substrate is riprap on the Northeast Shoreline Sediment Cap and whether the substrate is habitat mix on the Western Shoreline Habitat Bench.

If diver survey results reveal complete erosion of the under-pier sand cap that expose underlying sediments or complete erosion of the habitat mix on the habitat bench that exposes the underlying sand, additional diver transects will be performed to delineate the extent of this erosion. If any significant erosion of the riprap on the sediment cap is observed, the divers will determine the extent of this erosion.

4.2 UNDER-PIER CAPPED AREA SEDIMENT SAMPLING

4.2.1 Baseline and Long-term Monitoring Events

During the baseline survey, two surface sediment samples will be collected from each under-pier capped area transect by divers. These samples will be submitted to the laboratory for grain size analysis. Sampling methods will be performed very carefully so as to minimize disturbance of the cap. The collected samples will be visually logged to identify material stratification and physical properties.

For the routine long-term monitoring surveys or a supplemental surveys due to an earthquake, surface sediment samples will be collected by divers in the under-pier areas only if the diver is unable to visually determine and document the substrate type at any of the 10-foot monitoring stations along the transects. These samples will be analyzed for grain size distribution and compared to the grain size distribution of cap materials performed during the baseline survey to determine whether or not the material is similar to the sand used for capping.

4.2.2 Contingency Action Planning

If complete erosion of the sand cap material over a contiguous 5,000-square-foot area is observed in an under-pier area, Todd may collect surface samples of the underlying sediment. These underlying sediment samples will be collected by divers. The underlying sediment

sampled would be analyzed for all COCs. The number and location of samples to be collected will be determined based on the extent of the erosion and discussions with USEPA prior to sample collection. At each sample location, enough sediment will be collected by the divers to ensure adequate sample sediment volume is obtained for chemical testing. The required sample volume for sediment chemical analysis is presented in Table 4.1. The collected samples will be visually logged to identify material stratification and physical properties.

If the underlying sediment does not exceed the sediment cleanup criteria, listed in OMMP Table 1.1, material replacement is not required, and chemical sampling of adjacent open-water areas will not be performed. However, if underlying sediments are determined to contain COCs at concentrations above the cleanup criteria, chemical sampling of adjacent open-water areas will be performed. This sampling will be performed to determine whether erosion of under-pier sediments has caused recontamination of the adjacent open-water areas.

If sampling of open-water areas is determined to be necessary, Todd will prepare a map of proposed sediment sampling locations to include in the Contingency Action Planning Report, and will obtain USEPA's approval prior to collecting sediment samples. The sampling locations will be representative of the open-water bathymetry immediately adjacent to the area of complete erosion of under-pier cap material.

4.2.3 Sediment Sampling Procedures

During the baseline and long-term monitoring events, surface sediment sampling (0 to 10 cm below mudline) of the in-place cap material will be performed by divers using 10 cm diver cores. These samples will be collected for grain size testing. Contingency action planning sediment sample collection will also be performed by divers using 10 cm diver cores. These samples will be collected for chemical testing. All sediment samples will be collected in accordance with PSEP protocols, as specified herein. The general sampling procedures that will be used for the collection of the samples include the following:

- Diver will push the diver corer into the top 10 cm of the sediment.
- The sampling location and depth of overlying water will be recorded.
- The diver will guide the core sample on board the boat without disturbing the integrity of the sample.
- Visually classify the sample according to ASTM standards using the USCS and record on sampling form.
- Collect the sediment from the sampler and place into a clean stainless steel homogenization bowl.
- Thoroughly rinse interior of the sampling device until all loose sediment has been washed off.
- Samples will be accepted on the basis of the following criteria:
  - Sample does not contain significant debris material.
  - Sediment recovery is acceptable for testing purposes.
  - No significant leakage has occurred, as indicated by overlying water on the sediment sample surface.

  - No significant sample disturbance has occurred, as indicated by limited turbidity in the overlying water and a relatively flat sediment surface.
  - A core depth acceptable to the field personnel has been achieved.
- If the sample criteria are not achieved, the sample will be rejected and another core will be collected adjacent to the original sample location.
- Repeat core sampling process within a 10-foot radius of initial sampling location until sufficient sample is obtained to satisfy the sampling requirements for each location.
- Homogenize sediment sample until the sediment appears uniform in texture and color.
- Distribute sediment sample to appropriate sample containers and store in ice chest.
- Thoroughly decontaminate the sampler by following procedures in Section 4.2.4, Sediment Sampling Equipment Decontamination.

4.2.4 Sediment Sampling Equipment Decontamination

All sediment sampling equipment will be decontaminated between sediment stations according to standard decontamination procedures modeled after PSEP protocols (USEPA 1997a); however, the decontamination procedure will not use any acid or solvent rinses (the final rinse will use distilled water).

4.2.5 Sediment Sample Designations

All baseline and long-term monitoring sediment samples will be assigned a hyphenated alphanumeric code to designate the general location of the sediment sample, the sample date, the transect number, and the sample number along the transect. The sediment sample label will start with a general location code of “TS” for all sediment samples collected within the TSSOU, followed by the sample date, the “T#” for the transect number, and the sample number on the transect. For example, the second sediment sample collected on Transect 1 on September 30, 2007 will consist of the following sample label nomenclature: TS-093007-T01-02.

Contingency action planning sediment samples will also be assigned a hyphenated alphanumeric code to designate the general location of the sediment sample, the sample date, a “CONT” for contingency sampling, and the sample number. For example, the second contingency sediment sample collected on October 15, 2007 will consist of the following sample label nomenclature: TS-101507-CONT-02. QC samples collected during contingency sampling will also have unique identifications similar to the contingency sediment samples; however, “CONT” will be replaced with “BD” for blind duplicate, “FTB” for field transfer blank, or “FEB” for field equipment blank. For instance, the Sample ID for the first field equipment blank collected would be TS-101507-FEB-01. Because blind duplicates are used to test the accuracy of the analytical laboratory, the sample number will not be included on the sample label. For instance, a blind duplicate collected would be TS-101507-BD-01. Prior to sample collection, the field technician will record the sample label identification in the field log book with the corresponding time and date of sample collection.

4.2.6 Field Quality Control and Chain-of-Custody Record

Samples will be kept in sight of the sampling crew or in a secure, locked vehicle at all times. Samples will be transported to ARI at the end of each day for analysis. Transfer of samples from the sampling contractor to the laboratory will be documented using chain-of-custody procedures. If someone other than the sample collector transports samples to the laboratory, the collector will sign and date the Chain-of-Custody Record and insert the name of the person or firm transporting the samples under "transported by" before sealing the container with a Custody Seal.

4.2.7 Field Documentation

Sediment sampling activities will be recorded on field logs. The person completing the field logs will review all logs on a daily basis, so that any errors or omissions can be corrected. At the end of the day, all completed field logs will be provided to the Floyd|Snider Project Manager. Information that will be recorded during sediment sample activities will include the following:

- Date, time, and name of person logging the sample and field crew
- Weather conditions
- Sample location number
- Sample coordinates
- Depth of water at sample location
- Sampling equipment
- Penetration depth
- Physical description of sediment, including grain size, color, organic content, moisture content, presence of abrasive grit blast or other shipyard debris, biological activity, presence of sheens, odor, and any other distinguishing characteristics
- Time of sample delivery to the analytical and physical testing laboratory (chain-of-custody records)

4.3 LABORATORY ANALYSIS

Baseline and long-term monitoring sediment samples from the under-pier capped areas will undergo grain size testing to evaluate the stability of the sand cap over time. Contingency action planning sediment samples will undergo chemical testing to evaluate the quality of the exposed sediment surface in the under-pier areas or the quality of the sediment surface in the open-water areas adjacent to the under-pier areas. These contingency samples will be used to evaluate if the sediment is in compliance with SMS and TBT sediment cleanup criteria and to determine if material replacement of a cap is required.

4.3.1 Sediment Physical Analysis

All baseline and long-term monitoring sediment samples selected will be analyzed for grain size distribution using the PSEP method. The minimum sample volume is 16 ounces. Samples should be stored at 4°C and can be held for up to 6 months before analysis. Samples must not

be frozen or dried prior to analysis, as either process may change the particle size distribution. This information is summarized in Table 4.1.

4.3.2 Sediment Chemical Analysis

All contingency action planning sediment samples selected for chemical analyses will be analyzed for PAHs (LPAHs and HPAHs), PCBs, arsenic, zinc, copper, lead, mercury, TBT, and total organic carbon (TOC). Analytical methods that will be used for all chemical analyses are shown in Table 4.1. In addition, the scope of each analytical test and the associated test methods, including the lowest possible reporting limit achievable by ARI for each test method are shown in Table 4.1. SQS chemical criteria for the contingency action planning sediment samples are presented in OMMP Table 1.1. Specific analytical methods and QA procedures for chemical testing are provided in Section 5.0.

4.4 DOCUMENTATION AND NOTIFICATION

The documentation of baseline and long-term monitoring sediment sampling and grain size analysis, including all field documentation as described above in Section 4.2.7 and laboratory reports, will be submitted to USEPA as part of the physical integrity monitoring reports.

Contingency sediment sampling and chemical analysis documentation will be submitted to USEPA as part of the contingency action planning report. This report will include all field documentation on the sediment sampling and analytical laboratory reports.

5.0 Quality Assurance Project Plan

This QAPP establishes QC procedures and QA criteria to meet the DQOs set forth for the OMMP sampling to be conducted at the TSSOU. This QAPP was developed in accordance with the SMS guidance document (Ecology 1995); PSEP guidance documents (USEPA 1986, 1997a, 1997b, and 1997c); and USEPA guidance documents (USEPA 1998a and 1998b). In general, this QAPP follows very closely to the QAPP developed for the Remedial Action SAP (RASAP; FSM 2004).

5.1 DATA QUALITY OBJECTIVES

The DQOs for baseline and long-term physical integrity sediment sampling are to obtain the types and quantity of data in a manner such that the data are of known, appropriate, and sufficient quality to support the intended use, which is to evaluate the stability of the under-pier sand caps within the TSSOU over time. The DQOs for contingency action planning sediment sampling are also to obtain the types and quantity of data in a manner such that the data are of known, appropriate, and sufficient quality to support the intended use, which is to determine if material replacement of the under-pier sand cap is required and to determine if open-water sediment has been impacted by erosion of the under-pier sand caps. To accomplish these goals, project data should be technically sound, statistically valid, and properly documented, having been evaluated against established criteria for the principle data quality indicators (DQIs) (i.e., precision, accuracy, representativeness, completeness, and comparability [PARCC]) as defined in USEPA guidance (USEPA 1998a).

Data will be comparable with data collected during previous site investigations. Each QA/QC sample analysis will be documented with the same information required for the sample results. Data that will be provided by the laboratory to ensure DQOs are accomplished for the physical integrity sediment samples include internal laboratory data, such as sample storage and preparation logs, matrix duplicate analyses, and quantitative reports for the grain size analysis performed. The following list of data will be provided by the analytical laboratory to ensure DQOs for the contingency sediment sampling are accomplished:

- Method blank analyses will be reported for each sample and the concentration of all compounds of interest identified in those blanks.
- Surrogate spike recovery data will be reported including the name and concentration of all compounds added, percent recoveries, and range of recoveries.
- Matrix spike recovery data will be reported including name and concentration of all compounds added, percent recoveries, and range of recoveries.
- Matrix duplicate analyses will be reported.
- Relative retention times for each analyte detected in the samples.
- Internal laboratory data, including sample storage, extraction, and preparation logs.
- Instrument calibration logs.
- Quantitative reports for all analyses performed.

5.2 QUALITY CONTROL PROCEDURES

This section describes the procedures that will be implemented to:

1. Ensure sample integrity from the time of sample collection to the time of analysis in the laboratory.
2. Obtain the appropriate chemical and physical data.
3. Collect field and laboratory QC samples.
4. Monitor performance of the laboratory and field measurement systems.
5. Correct any deviations from the methods or QA requirements established in this QAPP.
6. Report and validate the data.

5.2.1 Sample Collection

Sample locations and sample collection methods for the sediment investigations are identified in detail in Section 4.0. Sampling procedures and protocols described in Section 4.0 are based on proven and acceptable sampling methods as established by PSEP. This section describes the procedures for sample collection required to meet the DQOs described in Section 5.1.

5.2.1.1 Sample Documentation

Sediment data and other relevant field information or activities will be documented in the field on appropriate forms and/or in field notebooks at the time of sampling. Sample container labels will be completed as described in Section 4.2.5 and affixed to each sample container. Each sample container will be labeled and recorded on a Chain-of-Custody Record as described below.

5.2.1.2 Equipment Decontamination

Sampling equipment will be properly decontaminated prior to collection of each sample to avoid cross contamination between samples. Decontaminated sampling equipment will be handled in a manner that minimizes contact with potentially contaminated surfaces. Specific procedures for sampling equipment decontamination are presented in Section 4.2.4.

5.2.2 Sample Handling

This section describes the procedures for sample handling following sample collection.

5.2.2.1 Sample Preservation and Storage

Samples submitted to the analytical and physical laboratory will be collected in the appropriate sample containers and preserved according to method specifications. Sediment sample storage temperatures and maximum holding times are presented in Table 4.1.

5.2.2.2 Sample Custody

The primary objective of sample custody is to create an accurate, written record that can be used to trace the possession and handling of samples so that their quality and integrity can be maintained from collection until completion of all required analyses. Adequate sample custody will be achieved by means of approved field and analytical documentation. Such documentation includes the Chain-of-Custody Record, which is initially completed by the sampler, and is thereafter signed by those individuals who accept custody of the sample. A sample will be considered to be in custody if it is:

- In someone's physical possession
- In someone's view
- Locked up or secured in a locked container or otherwise sealed so that any tampering would be evident
- Kept in a secured area, restricted to authorized personnel only

Sample control and chain-of-custody in the field and during transport to the laboratory will be conducted in general conformance with the procedures described in the following sections.

5.2.2.3 Field Custody Procedures

The following field custody procedures will be followed:

- As few persons as possible will handle samples.
- Sample bottles will be purchased directly from the manufacturer by Floyd|Snider or obtained new or pre-cleaned from the laboratory performing the analyses.
- The sample collector will be personally responsible for the completion of the Chain-of-Custody Record and the care and custody of collected samples until they are transferred to another person, or dispatched properly under chain-of-custody rules.
- The site Field Engineer will oversee implementation of the field custody procedures during the field work and, in the event of noncompliance will determine if corrective action is required.

5.2.2.4 Sample Shipment Custody Procedures

The following sample shipment custody procedures will be followed:

- The coolers samples are shipped in will be accompanied by the Chain-of-Custody Record identifying their contents. The original Chain-of-Custody Record and laboratory copy will accompany the shipment (sealed inside the shipping container). The other copy will be distributed as appropriate to Floyd|Snider's QA personnel.
- Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the "Remarks" section of the Chain-of-Custody Record and traffic report.

5.2.2.5 Transfer of Custody

The sample collector will sign the Chain-of-Custody Record in the first signature space. When samples are transferred, the individuals relinquishing and receiving the samples will sign the Chain-of-Custody Record and document the date and time of transfer. Each person taking custody will observe whether the shipping container is correctly sealed and in the same condition as noted by the previous custodian; deviations will be noted on the appropriate section of the Chain-of-Custody Record.

Floyd|Snider's QA Officer will verify project documentation of sample custody during regular review of the data validation package.

5.2.2.6 Laboratory Custody Procedures

A designated sample custodian at the laboratory will accept custody of the shipped samples, verify the integrity of the custody seals, and certify that the sample identification numbers match those on the Chain-of-Custody Record. If containers arrive with broken custody seals, the laboratory will note this on the Chain-of-Custody Record and will immediately notify Floyd|Snider's QA Officer. The laboratory will maintain sample security and custody as appropriate and as outlined in the laboratory's QAPP.

5.2.2.7 Sample Packaging and Shipping

The transportation and handling of samples will be accomplished in a manner that not only protects the integrity of the samples, but also prevents any detrimental effects due to the possible hazardous nature of samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the US Department of Transportation in the Code of Federal Regulations (CFR), 49 CFR 173.6 and 173.24 (USDOT 2002a, 2002b).

Prior to shipping, samples will be placed on sealed, reusable ice packs or double-bagged ice in coolers following collection. A picnic cooler will be used as a shipping container. In preparation for shipping samples, the drain plug will be taped shut, and a large plastic bag will be used as a liner for the cooler. When appropriate, approximately 1 inch of packing material will be placed in the bottom of the liner.

The sample bottles will be placed in the cooler containing ice or frozen gel packs. Samples will be packaged carefully to avoid breakage or cross contamination using sufficient packing material and will be shipped to the off-site analytical laboratory at the proper temperature (4°C). The Chain-of-Custody Record accompanying the samples to the laboratory will be placed inside a separate plastic bag and taped inside the cooler lid.

The cooler will be taped shut with strapping tape. Custody seals will be placed on the cooler. Samples will be transported to the laboratory within 24 hours of collection. The cooler will either be shipped to the laboratory by an overnight carrier or transported by automobile.

5.2.3 Sample Analysis and Testing

Analytical testing for grain size distribution will be performed on the baseline and long-term physical integrity monitoring sediment samples, while analytical testing for chemical and

conventional concentrations will be performed on the contingency action planning sediment samples. The contingency sediment samples selected for chemical analyses will be analyzed for PAHs (LPAHs and HPAHs), PCBs, arsenic, zinc, copper, lead, mercury, TBT, and TOC.

Standard USEPA sample preparation, cleanup, and analytical methods will be used for most chemical analyses, with the exception of some conventional parameters and the analysis of TBT. Additionally, PSEP-recommended guidelines for the measurement of organics, metals, and conventional parameters will also be followed (USEPA 1986, 1997b, and 1997c). The laboratory QAPP and standard operating procedures (SOPs) will provide data quality procedures at a level sufficient to meet the sampling program DQOs, according to the analytical protocols and cleanup steps for the method.

5.2.4 Field Quality Control Samples

Field QC samples will be collected during the contingency action planning sediment sampling to evaluate data precision, accuracy, representativeness, completeness, and comparability of the analytical results for this investigation. Collection of field QC samples will allow identification of potential problems resulting from sample collection and/or sample processing in the field. Field QC samples may include field duplicate samples and field blanks. A summary of the field QC samples and the frequency at which they will be collected and/or analyzed is described in the following subsections.

5.2.4.1 Blind Field Duplicate

A blind field duplicate will be collected at a frequency of at least one per 20 sediment samples, excluding QC samples. The blind field duplicate sample will consist of a split sample collected at a single sample location. Split samples will be submitted blind to the laboratory as discrete samples. These blind field duplicate sample results will be used to evaluate data precision.

5.2.4.2 Field Equipment Rinsate Blank

If unanticipated analytical results are encountered, a field equipment rinsate blank may be collected during the next sampling event to evaluate the effectiveness of sampling equipment decontamination procedures and the potential for equipment cross contamination. Field equipment rinsate blanks will be analyzed for all COCs.

Rinsate blanks will consist of deionized distilled water passed over and/or through decontaminated sampling equipment. The equipment surface exposed during sampling collection will be rinsed with the deionized water, which will be collected in the appropriate sample containers. Field equipment rinsate blanks will not be collected for dedicated or disposable field equipment.

5.2.5 Laboratory Quality Control Samples

Analytical laboratory QC samples will be collected to evaluate data precision, accuracy, representativeness, completeness, and comparability of the analytical results for the investigations. A summary of the QC samples and the frequency at which they will be collected and/or analyzed is described in the following subsections.

5.2.5.1 Laboratory Matrix Spike

A minimum of one laboratory matrix spike per 20 samples, not including QC samples, or one matrix spike sample per analytical batch of samples, will be analyzed for PAHs, PCBs, organotins, metals, mercury, and TOC. These analyses will be performed to provide information on accuracy and to verify that extraction and concentration levels are acceptable. The laboratory matrix spikes will follow USEPA guidance for matrix and blank spikes.

5.2.5.2 Laboratory Matrix Spike Duplicate

A minimum of one laboratory matrix spike duplicate per 20 samples, not including QC samples, or one matrix spike duplicate sample per analytical batch of samples, will be analyzed for PAHs, PCBs, and organotins. These analyses will be performed to provide information on the precision of chemical analyses. The laboratory matrix spike duplicates will follow USEPA guidance for matrix and blank spike duplicates.

5.2.5.3 Laboratory Duplicate

A minimum of one laboratory duplicate per 20 samples, not including QC samples, or one laboratory duplicate sample per analytical batch of samples, will be analyzed for mercury and metals. These analyses will be performed to provide information on the precision of chemical analyses. The laboratory duplicate will follow USEPA guidance in the method.

5.2.5.4 Laboratory Triplicate

A minimum of one laboratory triplicate per 20 samples, not including QC samples, or one laboratory triplicate sample per analytical batch of samples, will be analyzed for TOC and grain size distribution.

5.2.5.5 Laboratory Method Blank

A minimum of one laboratory method blank per 20 samples, one every 12 hours, or one per batch of samples analyzed (if fewer than 20 samples are analyzed) will be analyzed for all parameters (except grain size) to assess possible laboratory contamination. Method blanks will contain all reagents used for analysis. The generation and analysis of additional method, reagent, and glassware blanks may be necessary to verify that laboratory procedures do not contaminate samples.

5.2.5.6 Laboratory Control Sample

A minimum of one laboratory control sample per 20 samples, not including QC samples, or one laboratory control sample per sample batch if fewer than 20 samples are obtained, will be analyzed for all parameters, except grain size.

5.2.5.7 Surrogate Spike

All project samples analyzed for PCBs and TBT will be spiked with appropriate surrogate compounds as defined by the analytical methods.

5.2.6 Corrective Actions

Corrective actions will be needed for two categories of nonconformance:

- Deviations from the methods or QA requirements established in this QAPP
- Equipment or analytical malfunctions

Corrective action procedures to be implemented based on detection of unacceptable data will be developed on a case-by-case basis. Such actions may include one or more of the following:

- Altering procedures in the field
- Using a different batch of sample containers
- Performing an audit of field or laboratory procedures
- Reanalyzing samples (if holding times allow)
- Re-sampling and analyzing samples
- Evaluating sampling and analytical procedures to determine possible causes of the discrepancies
- Accepting the data with no action, acknowledging the level of uncertainty
- Rejecting the data as unusable

During the field operations and sampling procedures, field personnel will be responsible for conducting and reporting required corrective action(s). A description of any such action(s) will be entered in the field notebook. If field conditions are such that conformance with this QAPP is not possible, the Field Engineer will be consulted immediately. The Field Engineer will consult with Floyd|Snider's QA Officer, who may authorize changes or exceptions to the QA/QC procedures as necessary and appropriate. Any corrective action or field condition resulting in a revision the QA/QC procedures will be communicated to USEPA for review and concurrence.

During laboratory analysis, the laboratory QA Officer will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet data quality goals outlined in this QAPP, corrective action will follow the guidelines in the USEPA analytical methods noted in this QAPP and the USEPA guidelines for data validation for organics and inorganics analyses (USEPA 1999, 2004). At a minimum, the laboratory QA Officer will be responsible for monitoring the following:

- Calibration check compounds must be within performance criteria specified in the USEPA method or corrective action must be taken prior to initiation of sample analysis. No analysis may be performed until these criteria are met.
- Before processing any samples, the analyst should demonstrate through analysis of a reagent blank that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or

there is a change in reagents, a reagent blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.

- Method blank sample results should, in general, be less than instrument detection limits. If contaminants are present, then the source of contamination must be investigated, corrective action taken and documented, and all samples associated with a contaminated blank reanalyzed. If upon reanalysis, blanks do not meet these requirements, Floyd|Snider's QA Officer will be notified immediately to discuss whether analyses may proceed.
- Surrogate spike analysis must be within the specified range for recovery limits for each analytical method utilized or corrective action must be taken and documented. Corrective action includes: (1) reviewing calculations; (2) checking surrogate solutions; (3) checking internal standards; and (4) checking instrument performance. Subsequent action could include recalculating the data and/or reanalyzing the sample if any of the above checks reveal a problem. If the problem is determined to be caused by matrix interference, reanalysis may be waived if so directed following consultation with Floyd|Snider's QA Officer. If the problem cannot be corrected through reanalysis, Floyd|Snider's QA Officer will be notified by the laboratory prior to data submittal, so that additional corrective action can be taken, if appropriate.
- If the recovery value of a surrogate compound in the method blank is outside the recovery limits, the blank will be reanalyzed along with all samples associated with that blank. If the surrogate recovery value is still outside the limits, Floyd|Snider's QA Officer will be notified immediately to discuss whether analyses may proceed.
- If quantitation limits or matrix spike control limits cannot be met for a sample, Floyd|Snider's QA Officer will be notified immediately to discuss the corrective action required.
- If holding times are exceeded, all positive and non-detected results may need to be qualified as estimated concentrations. If holding times are grossly exceeded, the Floyd|Snider's QA Officer may determine the data to be unusable.

If analytical conditions are such that nonconformance with this QAPP is indicated, Floyd|Snider's QA Officer will be notified as soon as possible so that any additional corrective actions can be taken. The laboratory Project Manager will then document the corrective action by a memorandum submitted to Floyd|Snider's QA Officer. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and any recalculation, reanalysis, or re-extractions will be submitted with the data package in the form of a cover letter.

5.2.7 Performance Audits

Technical system audits (TSA) are thorough, systematic, and qualitative audits of the measurement system used in environmental data operations. In the event of a field or laboratory discrepancy, or QA concern, an audit for analytical laboratory procedures and/or field activities may be performed to determine whether environmental data collection activities and related results comply with DQOs. The TSA may be performed as an investigative tool to determine potential causes of the discrepancies. Following the audit, the management team will be provided with a detailed summary of findings, including detailed descriptions of any technical deficiencies. The purpose of the audit is to identify problems (if any), and present corrective

actions, which could benefit the project. Consequently, audit results will be presented in management terms and interests and will convince management of any proposed corrective actions to take for project improvement in the future.

Individuals performing an audit may interview personnel, witness operations, or examine equipment, training procedures, record keeping, data validation, data management, data analysis, and data reporting to determine potential out of compliance conditions. Performance audits will consist of quantitative data independently obtained for comparison with routinely obtainable data, and direct observation of work being performed, including inspection of equipment use, calibration methods, and sample collection procedures. A field audit will include direct observation of field activities. An internal laboratory system audit will consist of direct observation of the chemical analyses operations including inspection of equipment use, calibration, and maintenance of equipment to verify QA/QC requirements. External laboratory audits will review data management procedures, including chain-of-custody documentation for QA/QC adherence.

5.2.8 Data Validation and Reporting

Analytical reports from the laboratory for this project will be accompanied by sufficient backup data and QC results to enable reviewers to determine the quality of the data. Floyd|Snider's QA Officer is responsible to the Project Manager for conducting checks for internal consistency, transmittal errors, laboratory protocols, and for adherence to the QC elements specified in this QAPP.

The analytical laboratories will provide electronic deliverables that will include the following:

- Case narrative, including adherence to prescribed protocols, nonconformity events, corrective measures, and/or data deficiencies
- Sample analytical results
- Surrogate recovery values
- Matrix spike/matrix spike duplicate results
- Blank spike/blank spike duplicate results
- Laboratory duplicates
- Blank results
- Sample custody (including a copy of the signed, original Chain-of-Custody Records)
- Analytical responsibility
- Equipment calibration logging data
- Quantitation reports

A data validation report will be performed on laboratory data collected as part of sediment sampling activities. Validation will be performed in accordance with the appropriate sections of the USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review (USEPA 1999, 2004) and the Data Validation Guidance Manual for Selected Sediment Variables (PTI 1989) and will include evaluations of the following:

- Chain-of-Custody Records
- Holding times
- Field blanks
- Laboratory method blanks
- Surrogate recovery values
- Laboratory matrix spikes and matrix spike duplicates
- Blank spikes
- Laboratory duplicates
- Field duplicates
- Audit/corrective action records
- Completeness
- Overall assessment of data quality

Section 5.3 presents statistical tests and criteria used to determine data precision, accuracy, and completeness. In the event that a portion of the data does not meet the criteria specified in Section 5.3 or in the USEPA Contract Laboratory National Functional Guidelines for Organic and Inorganic Data Review (USEPA 1994, 1999), or sample collection and/or documentation practices are deficient, corrective action(s) will be initiated. Corrective action, as described in Section 5.2.6, will be determined by the Field Engineer and Floyd|Snider's QA Officer in consultation with the Project Manager and may include any of the following:

- Qualification of the data
- Rejection of the data and resampling
- Modified field and/or laboratory procedures

Data qualification arising from data validation activities will be described in the data validation reports, rather than in individual correction action reports.

5.3 QUALITY ASSURANCE CRITERIA

This section describes the DQIs and the associated QA criteria that will be used to ensure the data meet the DQOs identified in Section 5.2. As defined in the USEPA guidance, DQIs are quantitative statistics and qualitative descriptors used in interpreting the degree of acceptability or utility of the data (USEPA 1998a). The principal DQIs include the PARCC parameters (i.e., precision, accuracy, representativeness, comparability, and completeness). Secondary DQIs include quantitation limits, sensitivity, repeatability, reproducibility, recovery, and memory effects. Acceptance criteria for the DQIs and the quantitation limits have been established to

set quantitative goals for the quality of data generated in the analytical measurement process. These criteria are presented below and in Table 5.1.

5.3.1 PARCC Parameters/Limits

The statistical tests and target control limits (the range within which project data of acceptability should fall) for the PARCC parameters are described below. The target control limits will be used to evaluate data acceptability and are considered to be QC goals for data acceptance.

5.3.1.1 Precision

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed conditions. Precision is best expressed in terms of the standard deviation or relative percent difference (RPD). QA/QC sample types that test precision include field and laboratory duplicates and matrix or blank spike duplicates.

The estimate of precision of duplicate measurements will be expressed as an RPD value, which is calculated:

$$RPD = \left| \frac{D_1 - D_2}{(D_1 + D_2) \div 2} \right| \times 100$$

where: D_1 = first sample value
D_2 = second sample value (duplicate)

The target control limits for RPD values are presented in Table 5.1. The RPD values for duplicates will be routinely calculated and compared with these control limits. If duplicate sample values are within five times the quantitation limit, then the control limit interval will be plus or minus two times the quantitation limit.

5.3.1.2 Accuracy

Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property) X, with an accepted reference or true value T, usually expressed as the difference between the two values (X-T), the difference as a percentage of the reference or true value (100 (X-T)/T), or as a ratio (X/T). Accuracy is a measure of the bias in a system and is expressed as the percent recovery of spiked (matrix, surrogate spike, or laboratory control spike) samples:

$$\textit{Percent Recovery} = \frac{(\textit{Spiked Sample Results} - \textit{Unspiked Sample Results})}{\textit{Amount of Spike Added}} \times 100$$

The target control limits for percent recovery values are presented in Table 5.1. The percent recovery value will be routinely calculated and checked against these control limits.

5.3.1.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an actual condition or characteristic of a population. Representativeness can be evaluated using

replicate samples, representative sampling locations, and blanks. Representativeness for the sampling will be accomplished using appropriate selection of sampling location and analyzing method blanks to verify that the analytical results are representative of the sampled item and not influenced by cross-contamination.

5.3.1.4 Completeness

Completeness is a measure of the proportion of data obtained from a sampling event that is determined to be valid. It is calculated as the number of valid data points divided by the total number of data points requested. The QA objective for completeness during this project will be 95 percent, as listed in Table 5.1. Completeness will be routinely determined and compared to these control criteria.

5.3.1.5 Comparability

Comparability is an expression of the confidence with which one data set can be compared to another. QA procedures in this document will provide for measurements that are consistent and representative of the media and conditions measured. All sampling procedures and analytical methods used for sediment sampling activities will be consistent to provide comparability of results for samples and split samples. Data collected under this QAPP also will be calculated, qualified, and reported in units specified by the quantitation limits as listed in Table 5.1. These units have been selected to provide for comparability of the data with previously generated relevant site data and pertinent criteria.

5.3.2 Quantitation Limits

The quantitation limits (reporting limits) for each chemical analysis are targeted to be less than or equal to either the SQS criteria for sediment. Target reporting limits, where appropriate, as listed in Table 4.1 are the lowest possible reporting limits for each method as performed by ARI. The reporting limits listed are goals only, insofar as instances may arise where high sample concentrations, nonhomogeneity of samples, or matrix interferences preclude achieving the desired reporting limit and associated QC criteria. In such instances, the laboratory will report the reasons for deviations from these quantitation limits.

6.0 References

Floyd Snider McCarthy, Inc. (FSM). 2004. *Final Remedial Action Work Plan, Todd Shipyards Sediment Operable Unit*. 20 May.

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Table 4.1
Sediment Physical and Analytical Methodologies and Reporting Limits[1]

Analyte	Method	Reporting Limit	Reporting Limit Units	Storage Temperature	Maximum Holding Time	Minimum Sample Volume
Physical						
Grain Size	Plumb 1981	1	%	Cool, 4°C	6 months	16 oz. Jar
Organics						
PCBs	USEPA 8082	20 (per Aroclor, except Aroclor 1221, 40[2])	µg/kg	Cool, 4°C/ Freeze, -18°C	14 days/ 1 year	16 oz. Jar
PAHs (LPAHs and HPAHs)	8270 SIM	10	µg/kg (dry weight each PAH)	Cool, 4°C/ Freeze, -18°C	14 days/ 1 year	16 oz. Jar
Organotins						
Tributyltin	Krone et al. 1989	10	µg/kg (dry weight)	Cool, 4°C/ Freeze, -18°C	14 days/ 1 year	8 oz. Jar
Metals[3]						
Arsenic	USEPA 7060 GFAA	100	µg/kg (dry weight)	Cool, 4°C/ Freeze -18°C	6 months/ 2 years	4 oz. Jar
Copper	USEPA 6010 ICP	200	µg/kg (dry weight)	Cool, 4°C/ Freeze -18°C	6 months/ 2 years	4 oz. Jar
Lead	USEPA 7421 GFAA	100	µg/kg (dry weight)	Cool, 4°C/ Freeze -18°C	6 months/ 2 years	4 oz. Jar
Zinc	USEPA 6010 ICP	600	µg/kg (dry weight)	Cool, 4°C/ Freeze -18°C	6 months/ 2 years	4 oz. Jar

Table 4.1
Sediment Physical and Analytical Methodologies and Reporting Limits[1]

Analyte	Method	Reporting Limit	Reporting Limit Units	Storage Temperature	Maximum Holding Time	Minimum Sample Volume
Mercury	USEPA 7471 CVA	50	µg/kg (dry weight)	Freeze, -18°C	28 days	4 oz. Jar
Organic Carbon						
Total Organic Carbon (TOC)	ARI 602S/USEPA SW 9060	0.005	% (dry weight)	Cool, 4°C/ Freeze, -18°C	28 days/ 6 months	4 oz. Jar

Notes:
1 Reporting limits obtained from ARI laboratories.
2 Puget Sound Dredged Disposal Analysis protocol for low detection limits.
3 Reporting limits for metals in sediments assumes 100% total solids, no dilution required. If dilution is required, the reporting limits may be elevated.

Table 5.1
Summary of Sediment Quality Assurance Criteria[1]

Analyte	Units	Precision Control Limits[2]		Accuracy Control Limits[2]			
		MS/MSD RPD (%)	Duplicates RPD (%)	MS/MSD Recovery (%)	Surrogate Recovery	LCS Recovery (%)	Completeness (%)
PAHs	µg/kg (dry weight)	≤35	≤35	Lab	Lab	Lab	95
PCBs	µg/kg (dry weight)	≤35	≤35	Lab	Lab	Lab	95
TBT	µg TBT/kg (dry weight)	≤35	≤35	Lab	Lab	Lab	95
Arsenic	mg/kg (dry weight)	NA	≤20[3]	75-125	NA	Lab	95
Copper	mg/kg (dry weight)	NA	≤20[3]	75-125	NA	Lab	95
Lead	mg/kg (dry weight)	NA	≤20[3]	75-125	NA	Lab	95
Mercury	mg/kg (dry weight)	NA	≤20[3]	75-125	NA	Lab	95
Zinc	mg/kg (dry weight)	NA	≤20[3]	75-125	NA	Lab	95
TOC	% (dry weight)	NA	20[4]	75-125	NA	80-120	95

Analyte	Units	Precision Control Limits[2]		Accuracy Control Limits[2]			
		MS/MSD RPD (%)	Duplicates RPD (%)	MS/MSD Recovery (%)	Surrogate Recovery	LCS Recovery (%)	Completeness (%)
Grain Size	% (dry weight)	NA	20[4]	NA	NA	NA	95

Notes:

Lab The most current control limits established by the laboratory will be used.
NA Not applicable
PAHs Polycyclic aromatic hydrocarbons
PCBs Polychlorinated biphenyls
RPD Relative percent difference
MS/MSD Matrix spike/ Matrix spike duplicate
LCS Laboratory control sample
TOC Total organic carbon
TBT Tributyltin

1 Adapted from Table 6.2 of the Remedial Action Sampling and Analysis Plan (FSM 2004).
2 Precision and accuracy control limits are specified in Tables 5, 11, 12, and 13 of the *Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards* (Chapter 173-204-WAC) (Ecology 1995b).
3 If sample value is within 5 times the quantitation limit, then control limits shall be ± twice the quantitation limit.
4 35% relative standard deviation (RSD).